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ALOE SOAP VALUE CHAIN INTIATIVE AND ITS EFFECT ON LIVELIHOOD DIVERSIFICATION STRATEGY: THE CASE OF PASTORALISTS AND AGROPASTORALISTS OF BORANA, SOUTHERN ETHIOPIA

BY

TESHOME DEGA DIRBABA

JUNE 2014

ADDIS ABABA, ETHIOPIA

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A THESIS SUBMITTED TO ST. MARY'S UNIVERSITY, SCHOOL OF GRADUATE STUDIES, INSTITUTE OF AGRICULTURE AND DEVELOPMENT STUDIES, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF AGRICULTURAL ECONOMICS

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BOARD OF EXAMINERS

As member of Board of Examiners of Master's Thesis Open Defense Examination, we certify that we have read, evaluated the Thesis prepared by Teshome Dega Dirbaba and examined the candidate. We recommended that the Thesis be accepted as fulfilling the Thesis requirement for Degree of Masters in Agricultural Economics.

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DECLARATION

I, the undersigned, declare that this thesis is my original work, prepared under the guidance of **Dr Wondimagenye Chekol**. All sources of materials used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

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ENDORSEMENT

This thesis has been submitted to St. Mary's University, School of Graduate Studies for examination with my approval as a University Advisor.

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Advisor Signature

St. Mary's University, Addis Ababa **June 2014**

DEDICATION

I dedicated this Thesis manuscript to my sweetest wife Aynalem Amensisa for taking care of my lovely kids Mirkana, Boka, and Siriyan/Jalane/ during my absence, shouldering all the responsibilities, for her unreserved love and encouragement.

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LIST OF ABBREVIATIONS

AFD	Action for Development
ATT	Average Treatment Effect
ASALs	Arid and Semi-Arid Lands
BZFED	Borana Zone Finance and Economic Development
CC	Contingency Coefficient
CBO	Community Based Organization
CIA	Conditional Independence Assumption
CIDA	Canadian International Development Agency
COMESA	Common Market for East and Southern Africa
CSA	Central Statistical Agency
CITIES	Convention on International Trade in Endangered Species
DA	Development Agent
DDC	Dryland Development Center
DID	Double Difference or Difference-In-Differences
EPELP	Enhancing Pastoralist Environmental Right and Livelihood Project
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GHA	Greater Horn of Africa
GTZ	German Technical Cooperation
HH	Household
IBC	Institute of Biodiversity Conservation
IFPRI	International Food Policy Research Institute
IIED	International Institute for Environment and Development
ILRI	International Livestock Research Institute

IPMS	Improving Productivity and Market Success
ITDG	International Technology Development Group
IUCN	The World Conservation Union
KII	Key Informant Interview
NEMBA	National Environmental Management Biodiversity Act
NGOs	Non-Governmental Organizations
NTFPs	Non-timber Forest Products
NN	Nearest Neighbor
OBFED	Oromiya Bearu of Finance and Economic Development
OLS	Ordinary Least Squares
PA	Pastoral Associations
PPS	Probability proportional to size
PSM	propensity score matching
PSNP	Productive Safety Net Program
SNNPRs	Southern Nations Nationalities and People's Regional State
TLU	Tropical Livestock Unit
VIF	Variance Inflation Factor
UNDP	United nations Development Program
USD	United States Dollar

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ABSTRACT

This study aimed at assessing the effect of 'aloe soap value chain initiative' on pastoralists and agro-pastoralists in supplementing their livelihood diversification strategy to overcome impacts of recurrent shocks in the DidaYabello, Fulduwa and Dambala Badana Pastoral Associations (PA) in Yabello, Arero and Dire districts, respectively, of Borana Zone. Wild Aloe plant is one of the abundant plant species found in the area and most neglected/underutilized as means of livelihoods except few traditional medicines and ritual purposes. The research employed qualitative and quantitative research methods using both primary and secondary data. Purposive sampling method was used by which three sample PA administrations with potential aloe soap processing sub-centers were selected for data collection. A total of 120 sample households (60 participants and 60 nonparticipants) were selected by using probability proportional to size for the survey.

Data analysis was made by descriptive statistics and econometrics using propensity score matching method. This study therefore evaluates the effect of aloe soap value chain initiatives interventions of the project in the target PAs. The study has used cross-sectional survey data of 2012-2013 to see the effect of the intervention in supplementing their livelihood diversification strategy. The intervention has resulted in an increased amount of income made by participants to earn an average total income of about Birr 2688.70 per month *from the aloe soap production over the counter parts. It also enabled them to consider aloe plant as productive plant species which is market oriented and has best economic value. Moreover, the aloe plant species are found to be environmentally friendly, drought tolerant and best for soil and water conservation if properly used in addition to its magnificent medicinal uses. Based on the results obtained, such innovative product of market development interventions has a paramount importance for the enhancement of alternative livelihood diversification strategies of the pastoralists and agro-pastoralists.*

Key words*: pastoralist, recurrent drought, wild, Aloe soap, livelihood, propensity score matching*

1. INTRODUCTION

1.1 Background

In Greater Horn of Africa (GHA), pastoralism is one of the most important economic activities from which millions of people derive their livelihoods. Pastoralists in this region keep a significant part of their wealth in the form of livestock. For example, out of the total population, pastoral and agro-pastoral population are about 60% in Somalia; 33% in Eritrea; 25% in Djibouti; 20% in Sudan and 12% in Ethiopia (Coppock, 1994, quoted in Ahmed et al., 2001). Ouma et al., (2012) have described, a rapidly diminishing rangelands resource base and the continued fall in animal productivity, pastoral households suddenly found themselves in a situation where they have to seek alternative forms of livelihood to sustain their families. This situation has forced pastoralist to seek temporary income and subsistence bases; thus, livelihood diversification has become a common phenomenon among pastoral households.

Ethiopia is home for more than 12-15 million pastoralists and agro pastoralists who reside in 61% of the nation's landmass. The pastoral areas are estimated to comprise 42% of the national total livestock population. Livestock and livestock products provide about 12-17% of Ethiopia’s foreign exchange earnings, out of which hides and skins contribute about 90%. It contributes about 33% to the agricultural GDP and 16% to the national GDP (cited in Adugna, 2012). Livelihoods diversification is complex, and strategies can include enterprise development (Adugna and Wegayehu, 2012). Diversification of income sources, assets, and occupations is the norm for individuals or households in different economies, but for different reasons (Adugna, 2005).

Stark et al., (2011) has stated that in Borana alternative economic activities, such as trading, crafts, salt mining, incense and gum collection, and the harvesting of Aloe for soap and related production are generally better thought of as supplements to unstable pastoralist livelihoods which depends on livestock only rather than as fully supportive alternative livelihoods. Teshale (2011) also described that a variety of NGOs in Borana have been working to reverse the livelihood crises initiated by recurrent droughts. Currently, they have diversified their intervention approach from aid to strategies that bring long term livelihood

impacts. He further explained that some NGOs like AFD, GTZ, and SOS Sahel Ethiopia are working on improving the productivity of the gum and resin trees, trading access, and value addition.

Promoting alternative livelihood diversification strategies on non-timber forest product natural resources such as gum and resin production and trade in Borana has an invaluable importance to supplement the fragile livestock based livelihood. SOS Sahel Ethiopia has explored through its different projects the livelihood diversification potential of wild Aloe plant products such as aloe soap among others through value addition process. Accordingly, products of soaps from Aloe are already tested (Teshale, 2011) and it has continued implementing this livelihood activity since 2007 which is termed as 'Aloe soap value chain initiative'. Among many project intervention districts of SOS Sahel Ethiopia there were three Aloe soap producing pastoralist and agro-pastoralist groups/cooperatives in Yabello, Dire and Arero Districts. Hence, the research work focuses on the effect of this 'Aloe soap value chain initiative' in supplementing the livelihood diversification strategy of these households of the selected study area.

1.2 Statement of the Problem

Pastoralist and agro-pastoralist areas of Borana with their high degree of climatic variability and unpredictability have required flexibility, mobility and adaptation to different opportunities and challenges. The causes of these are traced by most of the literatures as settlement, population pressure, conflicts and the recurrent droughts (Little et al. 2004).

In Borana, pastoralism is the principal livelihood strategy with recent attempts to diversify into agriculture, forest products marketing, and petty trade (Tache and Oba, 2010). Simultaneous outbreaks of livestock diseases are common in pastoral areas and spread along the drought fronts, aggravating the number of animal mortalities. Therefore, pastoralists in general and the livestock in particular are vulnerable to unpredictable macro climatic variability (Amaha, 2006). Degradations in biological and physical rangeland resources have become serious challenges, bearing negative impacts on the pastoral ecosystems, livestock production and livelihoods thereof (Vetter, 2005).

Eyasu and Feyera (2010) stated that similar to other Sub-Saharan countries; the Ethiopian pastoralists have been subjected to political marginalization. The land alienation is behind many of the problems detected in the pastoral areas today. These problems include environmental degradation, food insecurity, drought vulnerability and ultimately destitution. The same authors has revealed that the root causes of these problems lies on the fact that policy tends to be biased against pastoralism in favor of alternative economic activities such as commercial agriculture, wildlife conservation parks and modern ranches.

The pastoralists in Borana have developed and practiced different types and forms of indigenous survival and adaptive strategies to cope with recurrent drought. Among, other things, digging of deep wells, mobility between wet and dry season grazing areas or rotational grazing, herd diversification, eating wild foods, splitting of herds and families, strategic settlement pattern and traditional supporting system are worth mentioned. However, "development interventions did not consider such knowledge because the pastoral production system was considered as backward and a factor for land degradation'' (Scoones, 1995 cited in Gamado et al., 2006).

The resilience of the pastoralist community has declined as drought frequency has increased. People have lost the capacity to recover from this crisis. The fact that droughts increasingly affected many households simultaneously means that "many of the informal mechanisms for mitigating and coping with risk become ineffective" (Skoufias, 2003). However, among these adaptive strategies, the importance and economic contribution of abundant and easily growing aloe plant species are not considered or is negligible. The economic potential of underutilized different wild Aloe plants species to improve alternative livelihoods of pastoralists and agro-pastoralists of Borana has not been yet realized. The abundant vegetation of Aloe plants were of no any recognized economic use to the community except few traditional uses as medicine and rituals. Moreover, before 'Aloe soap value chain initiative' was started, Aloe plants were rather considered as invasive plant species like bushes in the Borana rangeland.

Therefore, this study attempts to provide empirical evidence on the effect of innovative ideas started on Aloe soap making technology interventions held to supplement the livelihood diversification strategies of pastoral and agro-pastoral communities in selected site Dida

Yabello, Fulduwa and Dambala Bandana PAs of Yabello, Arero and Dire districts, respectively, in Borana Zone.

1.3 Objective of the Study

The overall objective of the study is to assess the effect of 'Aloe soap value chain initiative' intervention on supplementing pastoralist and agro-pastoralist household's livelihood diversification strategies in the study area. The specific objectives of the study are:

- Describe changes in the social, organizational and institutional aspects of aloe based livelihood diversification due to intervention in the target areas;
- Assess the effect of Aloe soap value chain initiative in supplementing livelihoods of target households in the study areas.
- Assess the prospects and determinant factors in Aloe based livelihood diversification in the study areas.

1.4 Significance of the Study

In Ethiopia, the analysis of economic effect of Aloe plant species product development on households' livelihood, are negligible. Hence, the study is aimed to bridge this research gap through providing useful information, knowledge and skill to enhance the effect of adoption of local Aloe soap making technologies in supplementing households' livelihood diversification strategy from an underutilized and neglected Aloe plant species. It has generated valuable knowledge to inform pastoralists and agro-pastoralists, donors, implementing agencies, policy makers and researchers for designing appropriate polices for intervening in the development of non-livestock sub–sectors mainly for ex-pastoralists and better rangeland management systems in the study areas.

1.5 Scope and Limitations of the Study

This study was carried out in three pastoral associations (PAs) Dida Yabello, Fuldowa and Dambala Badana in adjacent districts of Yabello, Arero and Dire, respectively, in Borana Zone major pastoral and agro-pastoral areas. During the field survey of this study, there are increasing numbers of aloe soap making groups being scaled up and aloe domestication sites

initiated in these target districts by different NGOs operating in the pastoral areas of the zone. The study covers one pastoral/agro-pastoral associations (PAs) from each district which are nearly close to each other implementing the Aloe soap making technology in their respective areas.

Due to budget and time limitations, only 120 pastoral and agro-pastoral sample households (60 participants and 60 nonparticipants into aloe soap making activity) from the three target PAs were included in the survey. Accordingly, the study was limited to the effect of wild Aloe soap processing on supplementing livelihood diversification strategies of target households. In addition, there is lack of baseline data; clear and wide range of previous empirical studies of propensity score matching (PSM) model particularly on the effect of Aloe soap value chain initiatives on household livelihood diversification strategy, its clear indicators for its measurements. Given all these limitations, the study has generated important information for the project owners as well as the policy makers.

1.6 Organization of the Thesis

The remaining chapters of the thesis are structured as follows. In chapter two reviews of theoretical and empirical literature related to Aloe plant, livelihood diversification, pastoral and agro-pastoral situations are presented. Chapter three and four deal with the research methodologies, results and discussion of the research, respectively. Finally, chapter five draws conclusions from the main findings of the study and suggests the possible policy implications.

2. LITERATURE REVIEW

2.1 Definition and Basic Concepts

Pastoralists are households where more than 50% household income/consumption is derived from livestock or livestock related activities, either as a result of sales of livestock products or of direct consumption, and agro-pastoralists as deriving 25-50% income/consumption from livestock produce Swift (1988) as cited in Adugna (2012),.

Pastoralism is considered as the most economically, culturally and socially appropriate strategy for maintaining the well-being of communities in dry land areas, because it is the only one that can simultaneously provide secure livelihoods, conserve ecosystem services, promote wildlife conservation and honor cultural values and traditions (ILRI, 2006). Moreover, pastoralism is the best means to make productive and sustainable use of natural resources in arid and semi-arid areas that would, otherwise, remain unexploited (FAO, 2006). The most common categorization of pastoralism is by the degree of movement, from highly nomadic through transhumant to agro-pastoral (Roger, 2001).

According to Odi (2010), there are four dominant livelihood systems in pastoral areas across the Horn of Africa in general and Borana in particular: 1) *Pure pastoral livelihoods*-livestock – based livelihoods; 2) A*gro-pastoral livelihoods* – these combine extensive livestock rearing and rain-fed cereal production; 3) S*edentary farmers* – practice mixed farming, cultivating food crops with modest sheep and goat herds; 4) E*x-pastoralists* – these are households who have lost their livestock and now depend largely on human labor.

Livelihood diversification: World Bank (2003) states “livelihood diversification as range of coping strategies, investments in livestock and non-farm income, and migration that are used to reduce fluctuations in income which also include traditional copying strategies”. Among many pastoralist groups in the Horn of Africa, diversifying is not new and has been combined historically with pastoral mobility. It is a form of risk management on a continuum with risk management within livestock production through mobility and flexible off-take strategies

(COMESA 2009). However, diversification is now also bound up with sedentarization (Fratkin 2012; Livingstone and Ruhindi 2012) - both forced sedentarization from loss of access to grazing lands and drought-related destitution, and proactive sedentarization to grasp new economic opportunities.

Pastoral livelihood diversification: is defined as the pursuit of any non-pastoral income-earning activity in both urban and rural environments (ILRI, 2000). This includes various forms of wholesale and retail trade (e.g. selling livestock, milk, hides and skins, honey, and artisan goods etc.), rental property ownership and sales, waged employment (local and non-local, including working as a hired herder, farm worker and migrant laborer), farming (subsistence and commercial), and the gathering and selling of wild products (e.g. gum arabic, firewood, or medicinal plants like Aloe) (Little, 2001).

Aloe soap value chain initiative: is an innovative idea of making soap locally from wild aloe sap initiated by SOS Sahel Ethiopia projects implemented in Borana rangelands since 2006 to enhance pastoral and agro pastoral livelihood diversification strategy. The aloe soap is made manually by the local community using simple and locally available materials except few industrial ingredients. The Aloe soap is made from formulated combination ratio of edible oil, caustic soda, water, perfumes, colors/dyes and drops of Aloe sap/exudate collected from Aloe plant species leaves' cut. Based on the interest of the target customer, different colors and perfumes are used for further attractiveness (SOS Sahel project reports). There are steps and given combination ratios of the ingredients with few minutes time to produce a batch of bars of Aloe soap.

2.2. Livelihood Diversifications

As stated by Kisiangani and Aziz (2011), pastoralism and agro-pastoralism are the dominant livestock production systems and opportunistic farming in most parts of Sub-Saharan Africa's arid and semi-arid zones, including Ethiopia. Grazing lands are being lost due to drought, increasing population pressure and restricted access to land. This is forcing more and more pastoralists to settle and grow crops, resulting in considerable reduction in grazing lands. Figure1 summarizes some of the livelihood diversification strategies among the Turkana people of North Kenya which is neighboring to Borana rangelands. Farming is the most

common form of livelihood diversification strategy with 60% of the target area. The farming type was mainly early maturing forms of grain crops such a sorghum and maize breeds. Aloe production contributes up to 15% and it was another common practice in the area (Ouma et al., 2012).

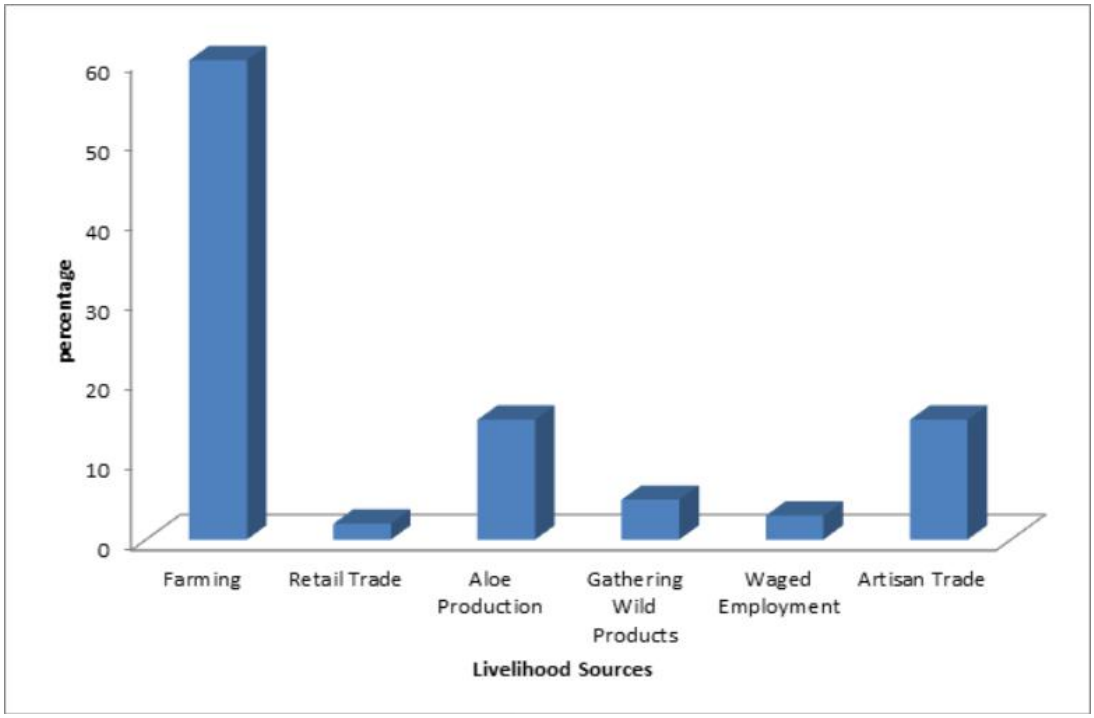


Figure 1: Livelihood diversification in North Kenya, Turkana
Source: Adapted from Ouma et al., 2012

Other studies done by UNDP (2006), Little (2001), Field (2005) and ITDG (2005b) all highlighted aloe farming as a form of livelihood diversification. Moreover, Practical Action (Formerly the ITDG, 2005b) has attempted to promote the production, processing and marketing of commercial Aloe vera.

Pastoralism in Ethiopia is the most important economic activity as many millions of people derive their livelihoods from this occupation. It has been variously estimated that about 12% of the populations of Ethiopian are engaged in this economy. As cited in Sileshi (2006), Coppock (1994) and Yemane (2000) have estimated that 30-40% of the livestock of Ethiopia are found in pastoral and agro-pastoral areas, which are mainly situated in the dry lands. The worth noting is that pastoralism in Ethiopia is both viable and vulnerable. Amaha (2006) has

revealed that the dry lands of Ethiopia are dominated by rangeland based livestock production systems known as pastoralism and agro-pastoralism (partly involved in opportunistic cropping) and represent a significant sector of the national agriculture in the country. The main reason for some households to follow diverse livelihoods is the household food shortage. Recurrent drought, degradation of natural resources and rapid population growth are among the main causes of declining per capita food production (FAO, 2006).

Livelihood diversifications is becoming the dominant activity for rural households who are most of the time affected by recurrent food shortage which is the main challenge, while they are dependent on a single livelihood activity driven by small landholding owing to over-population, low productivity due to land degradation and inability to use modern technology and shortage of input subsides from the government side. He added, land scarcity and low productivity in Ethiopia is forcing the rural household to engage in diversifying livelihoods to raise their income (Degefa, 2005).

2.2.1. Pastoral Livelihood Diversification Strategy in Borana

According to Hurst et al., (2012), the livelihood diversification strategies for most Borana pastoralists are beekeeping and honey, Aloe products (soaps and lotions), scent wood (similar to perfume or "locally named qayya"), incense and gum, poultry farming (for sale of birds in the market, not for direct consumption), charcoal, employment (local and distant eg. a family member relocates to Nairobi to seek employment), milk (for sale in local market only), gold mining, salt mining (sodda), cut firewood. These authors have also described that households cope with changing climate and social structures, many of them are choosing to increase the diversity of their livelihood strategies.

Moreover, Jibat et al., (2013) have also described that among livelihood options and food sources for the Borana people livestock-related livelihood options accounted for about 32% of the total means of food, social and economic contributions, whereas farming, food aid and petty trade contributed 21%, 15% and 14%, respectively. In addition, mining, charcoal production and employment are also mentioned as means of living (Figure 2).

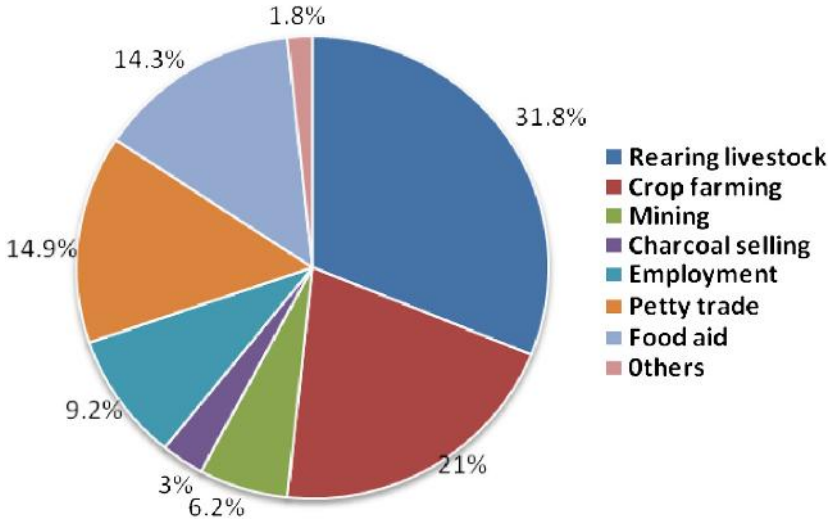


Figure 2: Livelihood Options for the Borana People

Source: Adapted from Jibat et al., 2013.

2.3. General Description of Aloe Plant Features, Products and Marketing

Different literatures showed that, the genus Aloe is represented in several biodiversity hotspots, including the Horn of Africa, Madagascar and Indian Ocean Islands, Maputaland-Pondoland-Albany, Cape Floristic Region and Succulent Karoo (Mittermeier et al., 2004; Myers et al., 2000) and includes many taxa that are naturally rare and geographically restricted (Oldfield, 2004). The majority of *Aloe* species occur in southern and eastern side of the African continent (Newton, 2004).

The term *Aloe* is derived from Arabic "alloeh" which means a bitter substance (Joseph and Raj, 2010). The leaf-succulent genus Aloe plants are perennial plants that comprise herbs, shrubs and small trees. Most Aloes are characterized by their thick and fleshy leaves with spiny margin. They have tubular flowers that are brightly yellow, orange or rarely white in color (Smith and Steyn, 2004 as cited in Fikre, 2012). Aloe comprises over 500 species, ranging from diminutive shrubs to large tree-like forms, with new taxa still being described regularly (Frodin, 2004), fully comprehensive studies of the taxonomy and biology of Aloe

plants are difficult and research to date has largely focused on geographical or taxonomic subsets.

Most aloes require rainfall of between 300mm to 850mm annually. Aloes have shallow roots and do well in fertile, rocky/gravel soil. Aloes grow well in soils with high nitrogen content (0.4 - 0.5 %), with pH range between 4.5 to 7.0 (Mukonyi, 2003). The species grow poorly in sandy soils and in areas prone to water logging.

In the flora of Ethiopia and Eretria, 46 species of Aloe have been described out of which 41 (89%) are endemic or near endemic indicating that they have high degree of endemism in the flora area. Only five species: *Aloe laterita, Aloe macrocarpa, Aloe rivae, Aloe secundiflora* and *Aloe vituensis* have wider distribution extending to east or West Africa. However, most other species have restricted distribution area and known from few localities and populations. The altitudinal distribution of Aloes in the flora area is wide ranging from 500m.a.s.l (e.g. *Aloe megalacantha* in desert and semi-deserts of Somalia region) to above 3000m.a.s.l (e.g. *Aloe steudneri* and *Aloe ankoberensis*), both of which reach the sub-afro-alpine vegetation (Sebsebe et al 2001; 2003; 2011).

The degree of endemism in the genus *Aloe* in the flora is therefore nearly three times higher than the average figure for all vascular plants (Friis *et al.,* 2001; Sebsebe Demissew *et al*., 2001). Only five species are wide spread extending to East Africa or West Africa: *Aloe lateritia, Aloe macrocarpa, Aloe rivae, Aloe secundiflora* and *Aloe vituensis* (Reynolds, 1966, Sebsebe Demissew & Gilbert, 1997, Sebsebe Demissew *et al.,* 2001).

Fikre (2012) described that though not yet fully investigated and exploited for their use as in other parts of Africa, Aloes in the flora of Ethiopia and Eretria may have potential economic and ecological values. The leaf gels from *Aloe debrana* and *Aloe trichosantha* are used in the manufacturing of sucks for coffee export. It has also been reported that *Aloe gilbertii* individuals are being used by the local community in rehabilitating degraded land (Fikre, 2006). *Aloe calidophilla*, a shrubby species with relatively wider range of distribution in the southern lowlands of Ethiopia including Borana pastoral areas and in the northern part of Kenya, is identified to be one of the commercially important species and listed among species that need conservation attention in Kenya (Wabuyele and Keyalo, 2008).

Plate 1: Typical Wild Aloe calidophilla Plant in Borana Rangelands

Source: Field survey 2014.

Wabuyele and Keyalo, (2008) described that most of the Aloes are exploited from the wild; it is only *Aloe Barbendensis (Aloe Vera)* which is under cultivation. *Aloe Vera* is the primary species selected for commercial production across the world for its active ingredients, high leaf gel content and strong growth history. *Aloe Ferox* is a species successfully exploited in the industry primarily in South Africa, African largest producer of Aloe-based products that are consumed in Africa. Aloe species propagation varies according to variety, however most of them propagate through suckers and a smaller proportion also through seeds.

The ethnobotany of Aloe is described in a considerable body of literature, analysis of which suggests most species are valued in some way and used on a local scale (Grace et al., 2008, 2009). For a specious genus of appreciable ethnological value, surprisingly few species of Aloe have been known in formal trade. It is described by same author that the market profiles of species such as *Aloe ferox Mill* and *Aloe vera* appear to be expanding, yet the trade in Aloe-derived products remains poorly understood and relevant information unavailable.

2.3.1 Aloe Plant Products

According to Ogola (2013), Aloe plant products at cottage industry and household level include like soap, shampoo, lotion and sale of Aloe bitter gum. Apart from the 'traditional' use of Aloes outlined here, commercialization of Kenyan Aloes occurs at two levels; in the last decade or so, the sap (exudate) of this species has gained popularity as an ingredient of 'homemade' soaps and detergents in many rural villages in Kenya. In this regard, individuals and community groups have taken to 'Aloe soap' making as a cottage industry to subsidize income. On the other hand, large-scale commercial extraction of Aloes targets markets abroad, mainly in Europe, and the Middle East (Oldfield, 2003) where it is used in the cosmetics and drug manufacturing industries. Farming of Aloes is a recent undertaking in Kenya, and no known plantations of mature plants exist. All known substantial harvesting of Aloes is from wild-growing populations. As noted by Newton (1994) attempts to establish plantations in the past have been inconsistent since whole plants were dug up from the wild for replanting on farmland.

Many supermarkets in Kenya stock *'Aloe vera'* juices and soaps that are locally manufactured and that have become quite popular in recent years. However, documentation of this trade is scanty and insufficient as a basis for identifying species and quantities exploited. A variety of indicators attest to the cultural and economic value of Aloe, such as the numerous vernacular names and uses recorded for the genus (Grace et al., 2008, 2009, 2011). The ethnobotany of Aloe is described in a considerable body of literature, analysis of which suggests most species are valued in some way and used on a local scale (Grace et al., 2008, 2009).

The economic scales at which Aloe is valued by people vary by orders of magnitude, from the rural poor whose sole livelihood is based on a single species of Aloe growing on communal lands, to agricultural economies based on several species of cultivated Aloe, and the extraordinary global production of *Aloe vera* (Grace, 2011).

2.3.2. Aloe Plants and their Role in Trade:

Grace (2011) stated that the commercial trade in Aloe-derived natural products is based mainly on two materials obtained from the leaves of certain Aloe species: leaf exudate- used in laxatives, and leaf mesophyll- used in products applied topically for skin ailments or taken internally for digestive complaints and general wellbeing.

Ogola (2013) described Aloe plant as drought tolerant, grows naturally, has an already established market, and can provide an alternative source of income. It has the potential to contribute to household food security through increased economic security, and should not threaten food production due to its ability to grow naturally in harsh environments. The same author stated that creation of alternative livelihood in micro-enterprises, commercializing Aloe production, beekeeping (honey/ wax production) and tourism activities will diversify income sources from livestock dependency. The author showed that the ethnobotanical survey of parts of Kenya has documented many uses of Aloes that were summarized as: a) Medicine (human and livestock), b) Fodder, c) Fencing and hedging, d) Soil conservation/compaction, e) Traditional brewing, and f) Cosmetic/beauty therapy.

In southern Africa, the current natural product trade is estimated at USD 12 million per annum, with potential to grow to USD 3.5 billion, half the value of current agricultural exports from the Southern African Development Community region (Bennett, 2006). A growing sector of commercial natural products employs up to nine million casual, largely female, workers. Niche markets for ecosystem products do indeed allow local people to make money. However, the risk of creating scarcities of valued products through exploiting common access resources unsustainably is a real one.

2.3.3. Aloe Commercial Extracts and Their Uses:

As described by Kavaka and Nellie (2008), different products can be extracted from various parts of aloe plant which includes flowers, leaves, stems and roots. There are different products from various parts of aloe plant such as from flowers – herbal tea; from leaves – sap/exudate, processed gum and gel; from stems and roots – fermentation catalyst, that is, the

dried stem and roots are ready for use in fermentation process. About 15 roots of *Aloe secundflora* are used to brew 20 Liters of alcohol.

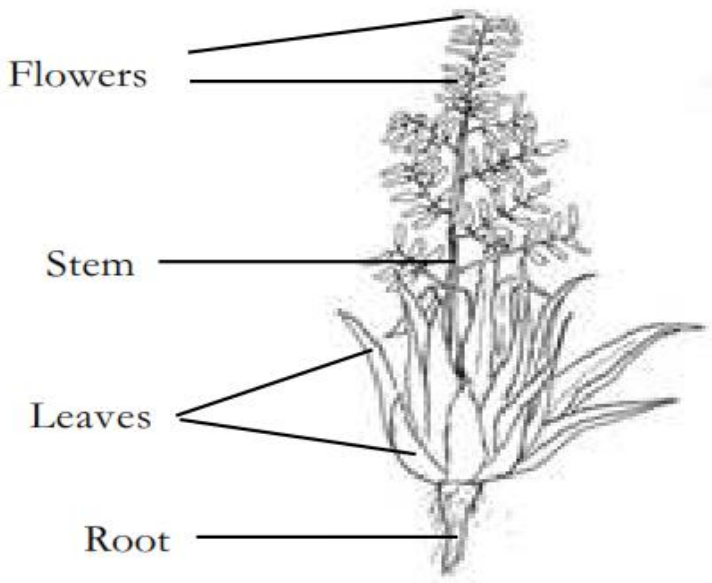


Plate 2: Various parts of Aloe plant from which products can be sourced
Source: Adapted from Kavaka and Nellie (2008)

Kavaka and Nellie (2008) have described that Aloe sap tapping occurs where the leaf is harvested. Harvesting sap is done when aloes are 3 to 4 years old. The sap is harvested immediately after the rainy season. Avoid harvesting during the rains or drought. Tapping is done between late morning and early afternoon on a hot still (not windy) dry day.

In Borana, the community collects sap/exudate from the most popular Aloe calidophila and Aloe Scandiflora and Aloe Scabrifolia to process their soap. These aloe plants have different capacity to generate sap/exudate (Table1). Hence, currently the aloe soap producers use 5 milliliters of aloe sap to produce 5000 grams of dry aloe soap or 10 bars (500 grams/bar) at production time. They use vegetable oil, caustic soda, water as a main ingredient, and dye (food color) or perfume will be added into it based on consumer preference.

Table 1: Sap Yield for Various Aloes in Different Localities in Kenya

Aloe Species	Site	Number of leaves harvested	Sap yield (mls)	Milliliters (mls) obtained per leaf
Aloe secandflora	Laikipia,	25	60	2.40
Aloe scabrifolia	Samburu,	22	60	2.73
Aloe calidophila	Moyale	20	120	6.00
Aloe rivae	Marsabit	19	35	1.84

Source: Adapted from Kavaka and Nellie (2008)

Plate 3: *Aloe Soap Products*

Source: Dida Yabello PA, 2014

Aloe calidophila is the most popular specie found in Borana range lands. As shown in table 1, it has high sap yield per leaf which has a paramount importance in aloe soap processing. Among the parts of aloe leaf (Figure 6) only its sap is currently used for the aloe soap making. But as many literatures show none of aloe plant parts (flower, stem, leaf and root) are wasted, i.e., all have their own economic value to the people growing it (Figure 5).

The selected community members were provided with technical trainings. The information obtained from the aloe producers groups/cooperatives and Milki Forest Products Marketing

Union shows that if all necessary ingredients and conditions are fulfilled or normal, a person can produce an average of 593 bars of soaps with 500gm. They are mostly challenged by the supply of vegetable oil and caustic soda which are not locally available.

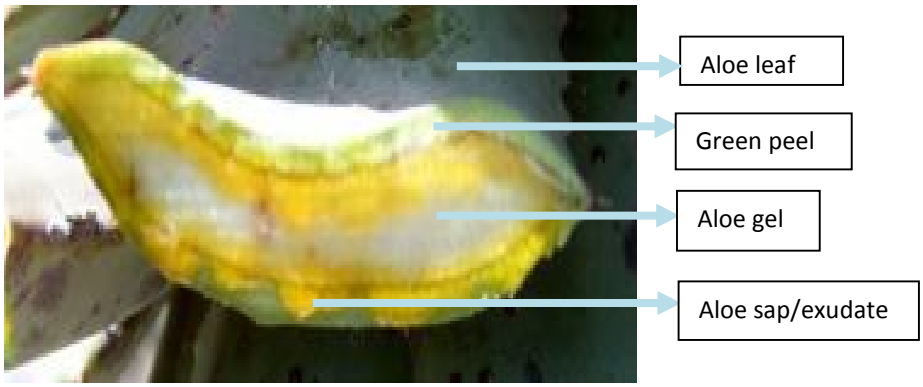


Plate 4: Exposed Inner Parts of Aloe Leaf Cut
Source: Photo from Field survey 2014

According to Joseph and Raj (2010), the bitterness of aloe plant results from the presence of aloin and aloe- emodin. Aloe vera secretes two types of fluid containing proteins and cellular elements. One is a reddish-yellow thick bitter fluid secreted from the pericyclic cells of the plant and the other, a transparent mucilage gel produced by tubular cells in the central parenchyma zone of the leaf (Joseph and Raj, 2011). These fluids are mainly used for laxative (reddish-yellow) and several medical (gel) purposes some of which will be summarized in the following sub sections.

In Ethiopia, Ermias Dagne (1996) has investigated the variation in the distribution of typical Aloe compounds in leaf exudates/sap (i.e. Aloenin, Barbaloin, Nataloin, Aloinoside, Homonataloin, 7-Hydroxyaloin, Aloesin and Microdontin) was reported among and between eleven species found in the country: *Aloe debrana, Aloe calidophila, Aloe camperi, Aloe elegans, Aloe sinana, Aloe megalacantha, Aloe pubescens, Aloe pulcherrima, Aloe rivae, Aloe secundiflora*, and one unidentified Aloe species. Similarly, *Aloe calidophila* yielded Homonatalion as its major constituent. Others, however, share one to three compounds between and among themselves, indicating some degree of relationships in their chemical composition.

2.3.4. Aloe as Horticulture

Grace (2011) described that Aloes are both decorative and highly collectable. They have become common in the general horticultural trade servicing gardeners and landscapers, particularly in the regions where the genus occurs naturally, as well as the specialist ornamental plant trade.

Gamba (2005) pointed out that by 2004 in Kenya drylands farmers in Kajiado and Samburu districts identified Aloe farming as a better alternative to wheat and livestock since the crop is drought tolerant, requires little tending and has a ready market.

There is no doubt that plant species that are endemic and rare; and also at the same time have potential economic value but under threat are of conservation priority (IBC, 2004). The reasons for rarity of a given plant species might be twofold: linked to the biology of the species such as population structure and reproductive strategies and also the ecology of the species distribution area (Reveal, 1997).

Sebsebe *et al, (*2001, 2003) and Fikre (2006) have identified most species which have very restricted distribution and put them in three local centers of endemism which has its own set of endemic taxa. For example, in southern highlands, lowlands and rift valley among identified nine endemic taxa are *Aloe calidophila*, *Aloe gilbertii* and *Aloe yavellana* are few of them. Fikre, (2006) has focused to compare the population structure and reproductive success of two selected *Aloe* species which are most popular in Borana Zone of southern Ethiopia: *Aloe calidophilla* (identified as commercially important and with relatively wider distribution range) and *Aloe yavellana* (narrow endemic and rare) so as to suggest appropriate conservation strategy.

Aloe calidophilla, a shrubby species with relatively wider range of distribution in the southern lowlands of Ethiopia and in the northern part of Kenya, is identified to be one of the commercially important species and listed among species that need conservation attention in Kenya (Wabuyele and Keyalo, 2008).

2.3.5. Aloe as Bee Plant:

Aloes are well-known bee plants in Africa. Species in flower during the dry season afford an important source of nectar for honey bees (Apismellifera) and nectariferous birds (Grace, 2011). In South Africa, *Aloe davyana* is the most highly regarded: extensive flowering stands of the species on the outskirts of Pretoria are used seasonally by beekeepers, who move their hives to these so-called "Aloe fields" in order to build up colonies, rear queens and increase colony numbers, as well as for winter honey production (Human and Nicholson, 2006).

Honey produced by bees foraging on *Aloe davyana* is pale in colour and free from any after-taste, except for a slight hint of smokiness (Glen and Hardy, 2000). It is not clear from the literature whether hives supported by Aloe species are kept only for subsistence, but it is likely that beekeepers may, at times, derive income from surplus honey and comb produced by their hives. On a commercial scale, at least one beekeeper in Kenya, near Nairobi, produces quality honey from a locally abundant species of Aloe (P. Latham, pers. comm.).

2.3.6 Aloes as Food

As cited in Grace (2011), there exists several species of edible Aloes, their uses including snack foods, famine foods, as a cooked vegetable and as an ingredient in preserves. It should be noted that not all species of Aloe are edible: some contain toxic alkaloids (Dring et al., 1984) and certain species, including *Aloe vera*, may cause adverse reactions (Steenkamp and Stewart, 2007). The cultivated species *Aloe arborescens* and *Aloe vera* have been used on a large scale in foodstuffs, especially in dairy products such as yoghurt and ice cream, in Asia and the United States for some years. In South Africa, a perceptible increase in the variety of manufactured food products containing *Aloe ferox*, such as confectionary and fruit juice blends, apparently mirrors the global rise in popularity of Aloe vera leaf mesophyll in foods. The use of *Aloe ferox* leaves in commercially manufactured preserves and condiments follows a centuries-old tradition of use in the Western Cape (Watt and Breyer-Brandwijk, 1962).

2.3.7. Aloe as Medicinal Uses

Wabuyele et al (2008) has explained that alongside other medicinal plants, extensive use of Aloes in treatment of human and livestock diseases in Africa has been documented. Indeed, in some areas of East Africa, herbal treatments are the only option for up to 80% of the population. According to same authors, up to 50% of the species were used as medicine, with malaria being the most common human sickness cured by Aloes. Other uses of Aloes include their use in traditional rituals and cultural practices in some groups of coastal Kenya. Generally, use of Aloes seems to be dictated by availability (distribution) as well as morphology; the widespread *Aloe secundiflora* was most popular as compared to less well known species; *Aloe lateritia* with its high leaf gel content was popular in beauty therapy and leggy species such as *Aloe kedongenis* were preferred as hedges. Species such as *Aloe ruspoliana* that are known to be poisonous are used for killing hyenas and wayward dogs in Northern Kenya.

As revealed by different literatures aloe plant has different composition and bioactive chemical that constituents of Aloe plant leaf. As shown in Figure6, the Aloe leaf is divided into two parts in general, an outer green rind and the inner colorless parenchyma containing gel (Hamman, 2008). The *Aloe vera* gel contains up to 99.5% water with an average pH of 4.5, the remaining 0.5-1% is solid material (Eshun and He, 2004; Hamman, 2008). Various chemical constituents have been isolated from both the solid and the gel material of the *Aloe vera* leaf (Appendix2). The solid material consists of many bioactive compounds. The many health benefits of *Aloe vera* have been attributed to its bioactive constituents found in the gel of the leaves (Hamman, 2008). Present in the gel are polysaccharides such as proteins, glucomannan, calcium, zinc, glucose, salicylic acid, vitamins, lignins, saponins and amino acids (Atherton, 1998). Chemical compounds such as anthraquinones (alion, aloe-emodin) are found in the latex leaf lining (Kemper and Chiou, 1999).

In southern parts of Ethiopia, Borana People Chew the stem and pith of Aloe shoots to apply on to a snake-bite, while the leaves are squeezed to obtain sap for treating ear pain, eye problems, skin wounds and burns (Abubeker, 2003). Moreover, root extracts are used to treat

stomach ache, epiphora, cold and flu. In addition, a piece of Aloe is frequently placed on top of huts to announce a birth (Coppock, 1994). Leaves of the Aloe plant are used by the Gerri people to treat burns, after drying, burning and mixing with water (Kebede, 2004) and protect tick infestations for livestock.

2.4. Empirical Studies

There is lack of available information on effect of 'Aloe soap value chain initiative' on livelihood diversification strategy studies. Therefore, only applications of the model used by different researcher are discussed. Below are reviews of some of the recent studies which applied propensity score matching (PSM) in program evaluations in Ethiopia and elsewhere.

PSM technique was applied by Jalan and Ravallion (2003) in their study on the benefit incidence of an antipoverty program in Argentina. Hope (in press) has conducted a study to evaluate social impacts of watershed development in India. The study was intended to estimate changes in gross agricultural returns from two crops and access to domestic water in rural villages following the introduction of watershed development project. The author adopted a PSM method to analyze the impact of the program on farmers' income and domestic water collection time. Esquivel and Pineda (2006) employed the PSM method in their study of the role of international remittance on poverty in Mexico using food-based, capabilities-based and assets-based outcome indicators.

Similarly, Mendola (2007) also applied a PSM technique to evaluate the impact of agricultural technology on household poverty in rural Bangladesh. The study found that the adoption of high yield variety of rice has a positive impact on farm household wellbeing. Allowing for interactions between agricultural technology and other determinants of income, the study quantifies the positive impact of technology adoption on resource-poor farmers, in terms of rise of income and poverty reduction. Furthermore, potential gains from agricultural technology are lower for near-landless and higher for small and medium-scale farmers. This might be evidenced by those directly achieving production enhancements in small and medium farms may have an important causal impact in terms of household wellbeing. On the other hand, technology adoption seems to increase income of poorer near-landless but it

hardly helps them to come out of the poverty line, unless other equity enhancing policy measures are undertaken.

Gilligan et al. (2008), used PSM method in analyzing the impact of social protection on food security and coping mechanisms in Ethiopia's productive safety nets program and they found that participation in the public works component of the PSNP (defined as receipt of at least 100 Birr) in payments over the first five months has modest effects. It improves food security by 0.40 months and increases growth in livestock holdings by 0.28 Tropical Livestock Units (TLU). It leads to an increase of 4.4% in the likelihood that a household is forced to make a distress asset sale.

In assessing the impact of the Productive Safety Net Program (PSNP) in Ethiopia on livestock and tree holdings of rural households, Andersson et al. (2009), have applied PSM model. They found that there was no indication that participation in PSNP leads households to disinvest in livestock or trees. In fact, the number of trees increased for households that participated in the program. It could be the case that participation in the PSNP, leads to households becoming more skilled in forestry, and that they switch to increased forest planting as a result.

Ibrahim (2012) has applied PSM in analyzing socio-economic impact of forage technology development on household livelihood in Mieso district. The study found that improved forage has significant positive impact on participated households' income, women working time, students' study time and expenditure on health services. Results further showed that, on average, improved forage adoption has increased physical income of participated households by 6,010.97Birr, which is approximately higher by about 41.81% than non-participants.

Tihitina (2011) has applied in assessing the impact of Input and Output Market Development Interventions by IPMS Project in Mieso Woreda of Oromiya National Regional State. The study found that the project has resulted in statistically significant market surplus which is the proportion of produce sold for participants. Participants sold about 68% more of onion and fattened goat about 20% and cattle about 25% to the market over non-participants.

Yemisirach (2010)) has applied assessing the impact of input and output market development interventions of the IPMS project at Alaba and Dale. The study found that after controlling the pretreatment differences the PSM, Kernel matching estimator, has resulted in a positive

and significant impact of input use, productivity, net income, marketed surplus and market orientation of treated households.

Yebeltal (2008) applied the PSM to assess the impact of Integrated Food Security Program in Ibant district of Amhara Region. The study found that the program has increased participating households' calorie intake by 30% (i.e., 698 calories) compared to the nonparticipating households.

Based on these empirical studies, this study used PSM method to evaluate the effect of 'Aloe soap value chain initiative' in supplementing livelihood diversification strategies of pastoral and agro-pastoral communities of Borana in the Southern Ethiopia.

3. RESEARCH METHODOLOGY

This part deals with the methodology of the study which embraces the agro-pastoral and pastoral households in the study area to be used in sample selection, gathering information and data analysis.

3.1 Description of the Programs

The Aloe soap value chain initiative is emanated from SOS Sahel Ethiopia's different programs/projects implemented in Borana rangeland since 2006. SOS Sahel Ethiopia is a resident charity organization currently operating in Amhara, Oromia and Southern Nation Nationalities and Peoples Regions State (SNNPRs) Regional States. SOS Sahel Ethiopia started piloting Aloe soap value chain initiative together with other components in Borana lowland by developing three projects. The first project is "Pastoralist food security partnership project (PFSPP)" funded by European Commission through Trocaire, CAFOD, SCIAF and Christian Aid implemented in partnership with Action for Development since 2006 in Borana and Guji Zones. The second project is "Value Chain Empowerment through Women-Led Initiative of Pastoral Community of Borana Project" funded by Oxfam Canada (CIDA) since 2007 and implemented in Yabello District. The third project is "Enhancing Pastoralist Environmental Right and Livelihood Project (EPELP)" in Borana and Guji Zones funded by Norwegian Peoples Aid (NPA) implemented since 2008 in Borana and Guji Zones to enhance the livelihoods of the pastoralist and agro-pastoralist communities through promoting participatory natural resource management system and commercializing non-timber forest products (NTFPs). These projects were implemented mainly in Yabello, Arero, Dire and Liban districts of the zones (SOS Sahel, 2009).

Hurst et al., (2012) confirmed that women who live in close proximity to forests or wooded areas may use products from the forest to supplement their incomes. Moreover, the same

authors have verified that SOS Sahel Ethiopia has helped a number of women to create and cooperatively run soap and lotion business in the Borana pastoral and agro-pastoral areas.

Based on these projects, the value addition and natural resource mapping, community action planning practices have become a strong initiative for the local people to sustainably manage and utilize the resources in which their livelihood depends. These projects have also helped the community to identify productive but underutilized plant species that have potential to produce different natural products such as Aloe, gum, resins/incense, myrrh or "qumbi" and scent wood, which can serve as the source of income generation. The projects have been implementing the integrated program activities, out of which 'Aloe soap value chain initiative' is derived to supplement the pastoralists and agro-pastoralists livelihood diversification strategies.

To effect this initiative the project have undertaken the assessment which include the botanical, bio-physical and vegetation cover of different Aloe species found in Borana rangelands. After identifying potential areas of Aloe vegetation the organization started pilot soap making training in Dida Yabello, Fulduwa and Dambala Badana PAs of Yabello, Arero and Dire districts, respectively. The target community members were organized in to groups, cooperatives and recently into NTFP producing and marketing Union at Borana Zone level as an apex institution to ease the provision of credit and input supply for the Aloe soap processing and other possible rangeland NTFPs.

3.2 Description of the Study Area

The study was conducted in Borana zone which is located in the Southern part of Oromiya National Regional State. The zone has 13 districts out of which about eight have pastoral and agro-pastoral ecosystem. Specifically, Yabello, Dire and Arero districts of Borana Zone which are very adjacent pastoral and agro-pastoral area were deliberately selected for the study purpose.

Location: Astronomically Borana Zone is located $3^0 26^1$ to $6^0 32^1$N latitude and $36^0 43^1$ to $40^0 46^1$E longitudes extending for about 3^0 or 331.6Kms North to South and for about 4^0 or 442.06Kms East to West and vice versa. Borana zone shares common boundaries with Guji Zone in the East, Somali Regional State in South-East, Southern Nations Nationalities and

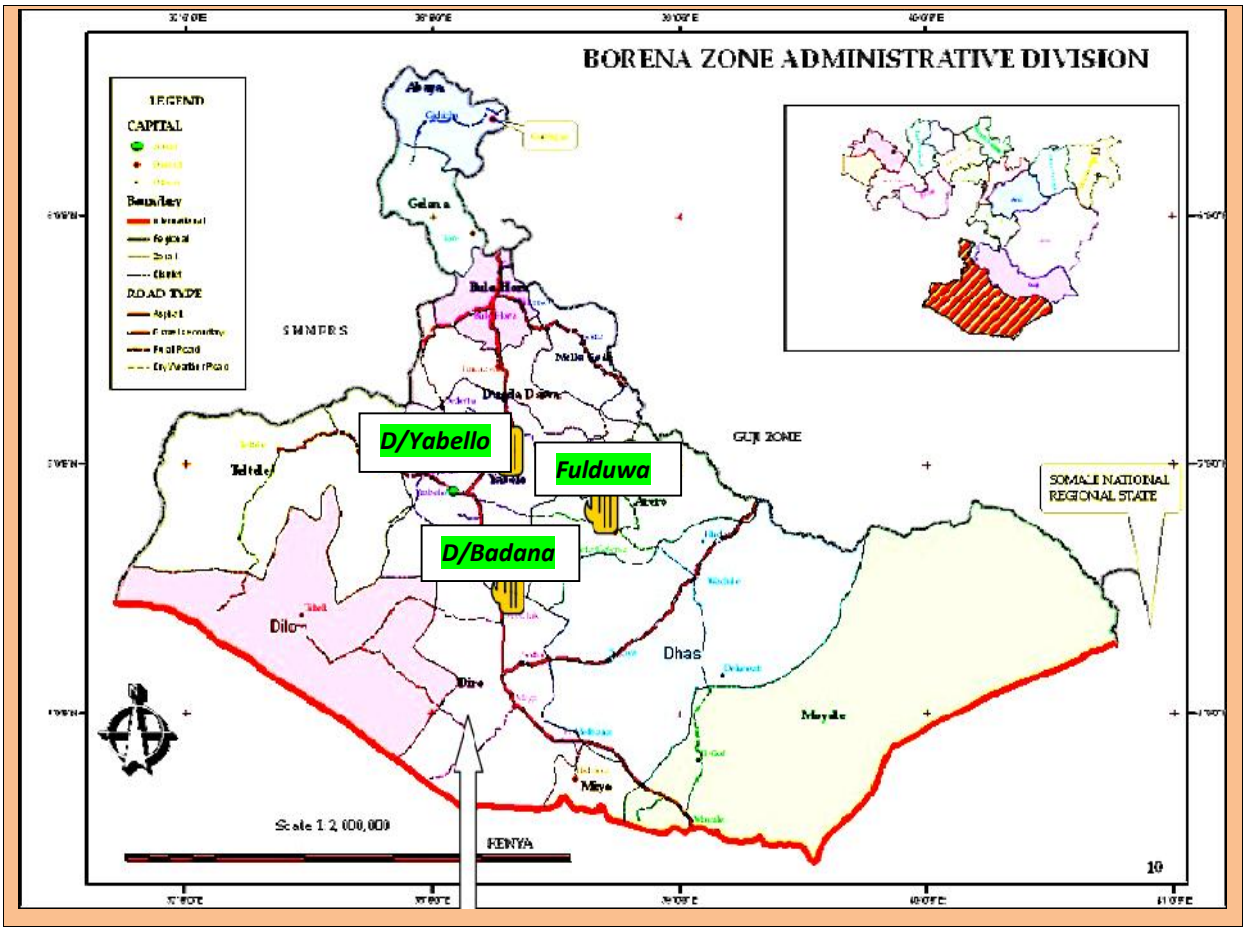
Peoples Region of Southern Ethiopia in the North and West, and one international boundaries with Kenya government in the South-West at 521Kms long and the zone has an area of 63,028Km^2 (BZFED, 2009) (Figure 7).

Climate: The Borana rangeland is characterized by arid to semiarid climate with extreme inter-annual rainfall variability (Coppok, 1994). The mean annual rainfall is about 500mm (Angassa and Oba, 2007). The rainfall is bimodal with long rains (*ganna*) that occurs between March and May and the short rains (*hagayya)* usually between September and October. The long rains account for 60% of the total annual rainfall, while the short rains contribute about 30% (Coppock, 1994). Pastoralists state that about 10% of the total rainfall is expected from the occasional rains termed as '*furmaata*, which offer irregular relief by interrupting the dry season stress on human and livestock populations. The mean annual temperature is about 24ºC with a mean maximum of 28ºC and mean minimum of 17ºC (Adefris, 2006).

Population: The current population of Borana is estimated at 1,178,690 of which 582,122 are female (CSA, 2008 and BZFEB 2009 forecast). The Borana Oromo are numerically the dominant ethnic group inhabiting the lowlands of Borana, and are predominantly pastoralists. Their economy is mainly based on cattle herding (Oba, 1998; Gemedo et al., 2005).

Vegetation: The vegetation is tropical savanna with varying proportions of open grassland, and perennial herbaceous and woody vegetation (Pratt and Gwynne, 1977). The Borana rangeland also has stretches of Acacia-Commiphora small-leaved deciduous woodlands, with a mixture of the genera Acacia, Boswellia and Commiphora. Other important genera include Boscia, Maerua, Lannea, Balanites and Aloe plants (Coppock, 1993; Gemedo et al., 2005; Adefris, 2006).

Figure 3: Location of the study area



Source: Borana Zone Finance and Economic Development (BZFED) Office, 2009

3.3. Required Type and Source of Data

In this study, both primary and secondary data were used. The data have both Quantitative and Qualitative nature. Enumerators who have at least college diploma, previous experience in data collection, know the local language and the context were recruited and trained. Before commencing data collection, the structured questionnaire was pre-tested to evaluate the appropriateness of the design, clarity and interpretation of the questions, relevance of the questions and time taken for an interview. Hence, appropriate modifications & corrections

were made on the questionnaire. Data was collected under continuous supervision of the researcher.

3.4. Sample Design and Size

The research design followed a multistage stratified sampling procedure. In the first stage, Yabello, Arero and Dire Districts where Aloe soap processing is being implemented in Borana Zone were selected purposively. In the second stage, three PAs (Dida Yabello, Fulduwa and Dambala Badana) were purposely selected from the three target districts, respectively; based on the Aloe soap production practices and the relatively abundant Aloe plant vegetation cover. Finally, a total number of 120 households were selected randomly from both participant and nonparticipant households in Aloe soap value chain initiative from the target PAs based on probability proportional to size (PPS).

Table 2: Distribution of Sample Households

Districts	PAs	Total HH	Participants		Non-participants		Total HHs
			Total	Sample	Total	Sample	
Yabello	Dida Yabello	816	73	28	743	18	46
Arero	Fulduwa	859	52	20	807	20	40
Dire	Dambala Badana	903	30	12	873	22	34
Total		2,578	155	60	2,423	60	120

Source: Field survey 2014

3.5. Methods of Data Collection

3.5.1. Primary Source

Primary data was collected from sampled respondents through pre-tested structured questionnaire from March to April 2014. The data focuses on the effects of the 'Aloe soap value chain initiative' induced and attitudinal characteristics of pastoralists/agro-pastoralists and the factors directly influencing their livelihood diversification strategies. Check lists were used to collect preliminary information about the study area. Five focused group discussion (FGD) with women, men, youth (boys and girls), elderly groups and one general discussion.

Each group was composed of 8 to 12 persons without repetition in each Dida Yabello, Fulduwa and Dambala Badana Pastoral Associations. There were different key informant interview (KII) conducted with two project staffs, two Zonal pastoral development office, and one staffs from each district Yabello, Arero and Dire Pastoral Development Offices (PDO) districts, one Gada leaders and one elders were contacted to support the formal survey. To collect reliable information, qualified enumerators were recruited and trained on how to collect the data using questionnaire, the survey instruments were scheduled for respondents during data collection.

3.5.2. Secondary Data Sources

Secondary data were collected from written documents obtained from Regional, Zonal, District level relevant sector offices and other non-governmental organizations' reports. Recent published articles and research findings at national and international level about the pastoral/agro-pastoral livelihood diversification, Aloe plant and Aloe product businesses were also used.

3.6 Data Analysis Method

In this study, the overall objective of the study is to assess the effect of Aloe soap value chain initiatives intervention on pastoral and agro-pastoral household's livelihood diversification strategies of the study area in supplementing their livelihood options. The study opts to use descriptive, qualitative and econometric analysis.

3.6.1. Descriptive Analysis

The effect of Aloe soap value chain initiative on pastoralist and agro-pastoralist households livelihood diversification strategy, the economic and social issue of the households', environmental and institution issues were analyzed from the survey data collected from individual household. The descriptive analysis uses tools such as minimum, maximum, mean, percentage, standard deviation, frequency distribution and T-test and chi-square statistics to compare participants and non-participant households in Aloe soap making processes.

3.6.2. Qualitative Data Analysis

Necessary information on changes in environmental, organizational and institutional aspect of Aloe soap value chain initiatives on pastoral and agro-pastoral households' livelihood, were collected from the community using focus group discussion, interviewing experts in different organizations in the district and community members; and reference made to secondary sources which were described and explained qualitatively as well as physical observation of the researcher. This information were also used to augment the quantitative analysis results.

3.6.3. Econometric Data Analysis

Foster, (2003) stated that distilling the effect of intervention per se from those factors that affect individuals in examining outcome response of an intervention involved is the central methodological challenge in non-experimental evaluation method. There are different econometric approaches that have been used to avoid or reduce this problem.

Double difference or difference-in-differences (DID): This is method in which one compares a treatment and comparison group (first difference) before and after a project (second difference). Comparators should be dropped when propensity scores are used and if they have scores outside the range observed for the treatment group. In this case potential participants are identified and data are collected from them. However, only a random sub-sample of these individuals is actually allowed to participate in the project. The identified participants who do not actually participate in the project form the counterfactual (Jalan and Ravallion, 1999; Baker, 2000).

A reflexive comparison: is the method in which a baseline survey of participants is done before the intervention and a follow-up survey, is done after. Here, participants who receive the intervention are compared to themselves before and after receiving the intervention. The counterfactual group is the set of participating individuals themselves (Jalan and Ravallion, 1999; Baker, 2000).

Propensity Score Matching (PSM): The PSM method as devised by Rosenbaum and Rubin (1983) can justifiably claim to be the solution to this problem, and thus to be the observational analog of a randomized experiment. The method balances the observed covariates between the treatment group and a control group (sometimes called comparison group for non-random

evaluations) based on similarity of their predicted probabilities of receiving the treatment (called their propensity scores). The difference between PSM and a pure experiment is that the latter also assures that the treatment and comparison groups are identical in terms of the distribution of all observed or unobserved characteristics. Hence, there are always concerns about remaining selection bias in PSM estimates.

Among quasi-experimental design techniques, matched-comparison techniques are generally considered a second-best alternative to experimental design (Baker, 2000). PSM tries to create the observational analogue of an experiment in which everyone has the same probability of participation. The difference is that in PSM it is the conditional probability (P(X)) that is intended to be uniform between participants and matched comparators, while randomization assures that the participant and comparison groups are identical in terms of the distribution of all characteristics whether observed or not. Hence, there are always concerns about remaining selection bias in PSM estimates (Ravallion, 2005).

In this study, PSM is used in measuring the effect of Aloe soap value chain initiatives on livelihood diversification strategies of the target households. PSM is a method that improves on the ability of the regression to generate accurate causal estimates by the virtue of its non-parametric approach to the balancing of covariates between the "treatment" and "control" group, which removes bias due to observable variables. According to Heckman et al., (1998), the conventional approaches to assessing the effect of an intervention on using with and without method, has essentially been hampered by a problem of missing data. Due to this problem, the effect of intervention cannot be accurately estimated by simply comparing the outcome of the treatment groups with the outcomes of control groups. One of the alternative techniques followed in recent literature to assess the effect of discrete treatment on an outcome is the method of propensity score matches developed by Rosenbaum and Rubin in 1983.

The matching econometric estimators are becoming increasingly popular among economists as the methods to measure impacts of program (Smith and Todd, 2005; Dehejia and Wahba, 2002; Heckman et al., 1998). The propensity score matching approach aims to build matched pairs of comparable users from the program participants and non-participants that show a similarity in terms of their observable characteristics. This is achieved by grouping

households from participated individuals and non-participated individuals in to Aloe soap making process simply which shows a high similarity in their explanatory variables.

Different authors have stated that statistical matching method is an alternative to econometric regression. With this method meaningful counterfactual (control) group will be selected among a large group of nonparticipants, which is identical to the participating group (Bryson et al., 2002; Caliendo and Kopeinig, 2005) to match the characteristics of the project population (causality of potential outcomes) as closely as possible. It matches control groups with treatment groups on the basis of observed characteristics or by a propensity (to participate) score; the closer this score, the better the match. A good control group is from the same economic environment and is asked the same questions by similar interviewers as the treatment group. Thus, to support the result obtained from regression analysis, the effect of Aloe soap value chain initiative approach is examined using econometric PSM method.

Estimating propensity score: is the first step in estimating the Aloe soap value chain initiative effect on livelihood diversification strategies of the target households. To get this propensity scores any standard probability model such as logit, probit or multi-nominal logit can be used (Rajeev et al., 2007). Since the propensity to participate is unknown, the first task in matching is to estimate this propensity. Any resulting estimates of program effect rest on the quality of the participation estimate. This can be routinely carried out using a choice model. The appropriate choice model depends on the nature of the program being evaluated. If the program offers a single treatment, the propensity score can be estimated in a standard way using a probit or logit model, where the dependent variable is 'participation' and the independent variables are the factors thought to influence participation.

In this study, the logit model was used to assess the effect of participating in 'Aloe soap value chain initiatives' on households' livelihood diversification strategy. Because, a logit regression of treatment status (1 if a household is participated in aloe soap processing, 0 if household non-participant) was run for the sampled households, on observables that include age, education, family size, experience in aloe soap making, access to market center, extension visits, livestock holding and access to rural credit services. The major concern of this regression was to predict the probability of a household to participated in aloe soap making used for supplementing pastoral and agro-pastoral households livelihood

diversification strategies, i.e., to predict propensity*-+y scores, based on which, the treatment and control groups of households were matched using the matching algorithms.

As cited by different authors, Pindyck and Rubinfeld (1981) have specified the cumulative logistic probability function as:

$$P_i = f(Z_i) = f[\beta_0 + \sum_{i=1}^{n} \beta_i X_i] = \left[\frac{1}{1+e^{-[\beta_0+\sum \beta_i X_i]}}\right] \quad (1)$$

Where: $\boldsymbol{e}$ = represents the base of natural logarithms (2.718…); $\boldsymbol{X_i}$ = represents the i^{th} explanatory variable; P_i = the probability that an individual participants in the Aloe soap value chain initiative intervention project; β_0 and β_i are parameters to be estimated.

Interpretation of coefficients will be easier if the logistic model can be written in terms of the odds and log of odds (Gujarati, 2004). The odds ratio implies the ratio of the probability that an individual will be a participant (P_i) to the probability that he/she will not be a participant ($1 - P_i$). The probability that he/she will not be a participant is defined by:

$$[1 - P_i] = \left[\frac{1}{1+e^{Z_i}}\right] \quad (2)$$

Using equations (1) and (2), the odds ratio becomes:

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \quad (3)$$

Alternatively, $$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{[\beta_0 + \sum \beta_i X_i]} \quad (4)$$

Accordingly, taking the natural logarithms of equation (4) will give the logit model as indicated below.

$$Z_i = ln\left|\frac{P_i}{1-P_i}\right| = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + - - - - + \beta_n X_n \quad (5)$$

Where, P_i is probability of participating in making Aloe soap that ranges from 0 to 1 and Z_i is a function of $\boldsymbol{n}$ explanatory variables X_i, β_0 is an intercept, $\beta_1, \beta_2, \ldots, \beta_n$ are the slope parameters in the model.

If we consider a disturbance term U_i, the logit model becomes:

$$Z_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + U_i \quad (6)$$

So, the binary logit will become: $Pr(P_{pt}) = f(X)$ (7)

Where, P_{pt} is project participation, $f(X)$ is the dependent variable project participation and *X* is a vector of observable covariates of the households:

PALVCI = f(X) = f[FSIZHH, SEXHH, AGEHH, EDUHH, ACRD, ACEXT, AMKT, TLU, PASP, KAEC, FMPASM, CMPASM, ASLDV, ALMKTY, ASCOMPT, PEASVCI, RDGT]

Where: PALVICI = Participation in Aloe soap making value chain initiatives; FSIZHH = family size of the household; SEXHH = sex of the household head; AGEHH = age of household head; EDUHH = education level of household head; ACEXT = access to extension service (DAs) of HH residence; ACRD = access to credit; AMKT = household Access to Market; TLU = size of livestock holding; PASP = perception of aloes soap; KAECU = knowledge about aloe plant economic uses; FMPASM = family members participating on aloe soap making; CMPASM = community income groups participating on aloe soap; ASLDV = aloe soap supplementing livelihood diversification; ALMKTY = aloe soap marketability in the local market; ASCOMPT = Aloe soap competency or preferability, PEASVCI = positive effects/rank of aloe soap value chain initiative in the area and RDGT = Recurrent drought.

3.6.4. Matching Algorithm Selection

The propensity score estimation by itself is not enough to estimate the ATT of interest. This is due to the fact that propensity score is a continuous variable and the probability of observing two units with exactly the same propensity score is, in principle, zero. Various matching algorithms have been proposed in the literature to overcome this problem. The methods differ from each other with respect to the way they select the control units that are matched to the treated, and with respect to the weights they attribute to the selected controls when estimating the counterfactual outcome of the treated. However, they all provide consistent estimates of the ATT under the CIA and the overlap condition (Caliendo and Kopeinig, 2008). The most commonly applied matching estimators only are described as below:

Nearest Neighbor (NN) Matching Estimator: According to Caliendo and Kopeinig (2008), this is the most straightforward matching estimator. An individual from a comparison group is chosen as a matching partner for a treated individual that is closest in terms of propensity score. NN matching can be done with or without replacement options. In the case of the NN matching with replacement, a comparison individual can be matched to more than one treatment individuals, which would result in increased quality of matches and decreased precision of estimates. In the case of NN matching without replacement, a comparison individual can be used only once. Matching without replacement increases bias, but, it could improve the precision of the estimates. In cases where the treatment and comparison units are very different, finding a satisfactory match by matching without replacement can be very problematic (Dehejia and Wahba, 2002).

Caliper Matching Estimator: As clearly stated, the above discussion tells that NN matching faces the risk of bad matches, if the closest neighbor is far away. To overcome this problem researcher's use the second alternative matching algorism called caliper matching. Caliper matching means that an individual from the comparison group is chosen as a matching partner for a treated individual that lies within a given caliper (propensity score range) and is closest in terms of propensity score (Caliendo and Kopeinig, 2008). If the dimension of the neighborhood is set to be very small, it is possible that some treated units are not matched because the neighborhood does not contain a control unit. One problem in caliper matching is that it is difficult to know a priori what choice for the tolerance level is reasonable.

Kernel Matching Estimator: According to Becker and Ichino (2002), it is a matching method whereby all treated units are matched with a weighted average of all controls with weights which are inversely proportional to the distance between the propensity scores of treated and controls. Kernel weights the contribution of each comparison group member, so that more importance is attached to those comparators providing a better match. The difference from caliper matching, however, is that those who are included are weighted according to their proximity with respect to the propensity score. The most common approach is to use the normal distribution (with a mean of zero) as a kernel, where the weight attached to a particular comparator is proportional to the frequency of the distribution for the difference in scores observed (Bryson *et al*., 2002).

According to Caliendo and Kopeinig (2008), the drawback of this method is that possibly bad matches are used as the estimator includes comparator observations for all treatment observation. Hence, the proper imposition of the common support condition is of major importance for kernel matching method. A practical objection to its use is that it will often not be obvious how to set the tolerance. However, according to Mendola (2007), kernel matching with 0.25bandwidth is most commonly used.

The question remains on how and which method to select. Clearly, there is no single answer to this question. The choice of a given matching estimator depends on the nature of the available data set (Bryson *et al*., 2002). After obtaining the predicted probability values conditional on the observable covariates (the propensity scores) from the binary estimation, matching will be done using a matching algorithm that is selected based on the data at hand. Then the effect of household's participation in the Aloe soap value chain initiative supported by SOS Sahel Ethiopia's intervention on a given outcome (outcome in this study is the additional income obtained due to Aloe soap value chain initiative) (Y) is specified as:

$$\tau_i = Y_i(D_i = 1) - Y_i(D_i = 0) \quad (8)$$

Where τ_i is treatment effect (effect due to participation in the Aloe soap making process), Y_i is the outcome on household i, D_i is whether household i has got the treatment or not (i.e., whether a household participated in the Aloe soap making innovative approach or not).

However, one should note that $Y_i(D_i = 1)$ and $Y_i(D_i = 0)$ cannot be observed for the same household at the same time. Depending on the position of the household in the treatment (Aloe soap value chain initiatives), either $Y_i(D_i = 1)$ or $Y_i(D_i = 0)$ is unobserved outcome (called counterfactual outcome). Due to this fact, estimating individual treatment effect τ_i is not possible and one has to shift to estimating the average treatment effects of the population than the individual one. Most commonly used average treatment effect estimation is the 'average treatment effect on the treated (τ_{ATT}), and specified as:

$$\tau_{ATT} = E(\tau / D = 1) = E\left[\frac{Y_{(1)}}{D=1}\right] - E\left[\frac{Y_{(0)}}{D=1}\right] \quad (9)$$

As the counterfactual mean for those being treated, $E\left[\frac{Y_{(0)}}{D=1}\right]$ is not observed, one has to choose a proper substitute for it in order to estimate the average treatment effect (ATT). One may

think to use the mean outcome of the untreated individuals, $E\left[\frac{Y_{(0)}}{D=0}\right]$ as a substitute to the counterfactual mean for those being treated $E[\frac{Y_{(0)}}{D=1}]$. However, this is not a good idea especially in non-experimental studies. Because, it is most likely that components which determine the treatment decision also determine the outcome variable of interest.

In this particular case, variables that determine household's decision to participate in the Aloe soap making process developed by the project interventions could also affect household's input use intensity, level of productivity, household income, etc. Therefore, the outcomes of individuals from treatment and comparison group would differ even in the absence of treatment leading to a self-selection bias. By rearranging, and subtracting $E\left[\frac{Y_{(0)}}{D=0}\right]$ from both sides, one can get the following specification for ATT.

$$E\left[\frac{Y_{(1)}}{D=1}\right] - E\left[\frac{Y_{(0)}}{D=0}\right] = \tau_{ATT} + E\left[\frac{Y_{(0)}}{D=1}\right] - E\left[\frac{Y_{(0)}}{D=0}\right] \quad (10)$$

Both terms in the left hand side are observables and ATT can be identified, if and only if $E\left[\frac{Y_{(0)}}{D=1}\right] - E\left[\frac{Y_{(0)}}{D=0}\right] = 0$; i.e., when there is no self-selection bias. This condition can be ensured only in social experiments where treatments are assigned to units randomly (i.e., when there is no self-selection bias).

3.6.4.1. Assumptions

In non-experimental studies one has to introduce some identifying assumptions to solve the selection problem. The following are two strong assumptions to solve the selection problem.

A) Conditional Independence Assumption (CIA): It is given as:

$$Y_0\, Y_1 \perp \frac{D}{X}, \forall X, \quad (11)$$

Where, ⊥ indicates independence, X -is a set of observable characteristics, Y_0 - Non-participants and Y_1-Participants.

Therefore, given a set of observable covariates (X) which are not affected by treatment (in our case, Aloe soap making participant), potential outcomes (level of productivity, income, etc) are independent of treatment assignment (independent of how the Aloe soap making participation decision is made by the household). This assumption implies that the selection is

solely based on observable characteristics and variables that influence treatment assignment (Aloe soap making participation decision is made by the household) and potential outcomes (productivity level, income, etc) are simultaneously observed (Bryson *et al*., 2002; Caliendo and Kopeinig, 2008).

After adjusting for observable differences, the mean of the potential outcome is the same for $D = 0$ and $D = 1$, and $E(Y_0/D = 1, X) = E(Y_0/D = 0, X)$. Instead of conditioning on X, Rosenbaum and Rubin (1983), suggest conditioning on a propensity score (propensity score matching). The propensity score is defined as the probability of participation for household i given a set X which is household's characteristics $P(X) = pr(D = 1/X)$. Propensity scores are derived from discrete choice models, and are then used to construct the comparison groups. Matching the probability of participation, given covariates solves the problem of selection bias using PSM (Liebenehm *et al.*, 2009). The distribution of observables X is the same for both participants and nonparticipants given that the propensity score is balancing score (Liebenehm *et al.*, 2009). If outcomes without the intervention are independent of participation given X, then they are also independent of participation given $P(X)$. This reduces a multidimensional matching problem to a single dimensional problem. Due to this, differences between the two groups are reduced to only the attribute of treatment assignment, and unbiased impact estimate can be produced (Rosenb aum and Rubin, 1983).

B) Common support Assumption: It rules out perfect predictability of D given X. That is, $0 < P\left[\frac{D=1}{X}\right] < 1$. This assumption ensures that persons with the same X values have a positive probability of being both participants and non-participants. Given the above two assumptions, the PSM estimator of ATT can be written as:

$$\tau_{ATT}^{PSM} = E_{\substack{P(x)\\D=1}} \{E\left[\frac{Y(1)}{D=1}, P(X)\right] - E[\frac{Y(0)}{D=0}, P(X)]\} \qquad (12)$$

Where ***P(X)*** is the propensity score computed on the covariates ***X***. Equation (12) is explained as the ***PSM*** estimator is the mean difference in outcomes over the common support, appropriately weighted by the propensity score distribution of participants.

3.6.5. Variable Definition and Measurement

3.6.5.1. Dependent Variable (Yi)

The dependent variable for this study is participation into a program which takes the value of 1 if the household participated in Aloe soap making technology and zero otherwise.

Income: This refers to the total income from Aloe soap sell, crops sell, livestock and their products sales and income generated from off/non-farm activities per month. Adoption of Aloe soap making technology is hypothesized to increase total income of the households.

3.6.5.2. Independent Variables

Age of Household Head (AGEHH): It is a continuous variable and measured in years. Aged households are believed to be wise in resource use, on the other hand, young household heads have long investment horizon and it is expected to have either positive or negative effect on volume of Aloe soap processing. Adugna (2009) found that age of the household head have negative effect on the elasticity of onion supply to the market. Thus, age of the HH is hypothesized to have a positive relationship with participation choice decision of Aloe soap producers.

Sex of the Household Head (SEXHH): It is a dummy variable taking zero if female and one if male for variable to be considered. Culturally defined gender roles, social mobility limitations and differential ownership of access to assets affect livelihood diversification (Galab et al., 2002). Awol (2010) indicated negative relation between sale volume of poultry and male-headed household. Mamo and Deginet (2012) found that sex of the household head has statistically significant effect on whether or not a farmer participates in the livestock market and his/her choice of a market channel. Thus, keeping the influence of other factors constant; the likelihood of women's choice of participation in Aloe soap processing livelihood diversification strategy increases.

Distance from Market (DMKT): It is a continuous variable measured as the distance in kilometer (Km) that the household travel to reach the nearby market. The closer the market, the lesser would be the transportation charges, reduced walking time, and reduced other

marketing costs, better access to market information and facilities. In this study, distance to nearest market is hypothesized to have a positive contribution to the adoption and households' participation in an innovative Aloe soap value chain initiatives as their alternative livelihood diversification strategy.

Credit Access (CRDAC): This is a dummy variable taking the value one if the household takes loan and zero otherwise, which indicates credit taken for Aloe soap production. Access to credit would enhance the financial capacity of the households to purchase the inputs, thereby increasing Aloe soap production and market share size. Urquieta (2009) found that access to loan was significant determinant of choices. It is also hypothesized that access to credit would have influence on households' choice decisions. Therefore, it is hypothesized that access to credit will have positive effect on level of participation and technology adoption in Aloe soap value chain initiatives.

Access to Extension Service (ACEXT): A dummy variable taking a value of one if Aloe soap producer household has access to extension service and zero otherwise and representing extension services as a source of information on technology. It is expected that extension service widens the household's knowledge with regard to the use of improved technologies, wild Aloe plant conservation and domestication; promotion of economic and medicinal uses of Aloe; and has positive impact on Aloe soap value chain initiatives volume. Therefore, this variable is hypothesized to influence participation in Aloe soap value chain initiatives positively.

Education of the Household Head (EDUHH): It is a binary variable measured in terms of whether the household has a formal education at different level from illiterate to Grade 12. Education broadens pastoralists and agro-pastoralists' intelligence and enables them to perform the Aloe soap production activities perceptively, accurately and efficiently. Moreover, better educated households tend to be more innovative and are therefore more likely to adopt the Aloe soap processing technology and systems. Formal education enhances the information acquisition and adjustment abilities of the household, thereby improving the quality of decision making (Fakoya*et al*., 2007). Astewel (2010) found that if paddy producer gets educated, the amount of paddy supplied to the market increases, which suggests that

education improves level of participation and sales that affects the marketable surplus. Therefore, education of the HH head is hypothesized to influence the probability of choice of participation in Aloe soap value chain initiative in supplementing HHs' livelihood diversification positively.

Livestock (TLU): This is a continuous variable measured in tropical livestock unit. Pastoralists who have large livestock are anticipated to specialize in livestock production so that they encourage allocating large share of the communal land for pasture. As Aloe covers most of the grazing land, the higher the Aloe plant vegetation, the lesser the pasture will be. On the other hand, it is assumed that household with larger TLU have better economic strength and financial position to purchase sufficient amount of input (Kinde, 2007). But for this study TLU is hypothesized to influences volume of Aloe soap processing negatively.

Family Size (FSIZHH): Family size of a respondent is a continuous variable measured in terms of number of family members and expected to affect the household's adoption of this innovative Aloe soap making technology. As Aloe soap production is labor intensive activity, Aloe soap production in general and market supply of Aloe soap products in particular is a function of labor. Accordingly, families with more household members tend to have more labor which in turn increase participation in Aloe soap processing and then increase Aloe soap production. On the other hand, family size also decreases market supply because high proportion of the product would be used for consumption. Anyways, for this study family size is expected to influence positively the participation in Aloe soap value chain initiative and the adoption of the new and simple Aloe soap making technology.

Membership to Cooperative (MCOOP): It is dummy variable and takes the value of one if the household is member of the aloe soap making cooperatives engaged in business, otherwise zero. It is expected to be associated with participation choice decision of Aloe soap producers.

Recurrent Drought (RDGT): It is a dummy variable measured in terms of whether the livestock and crop production is decreased as compared to the normal time. It takes the value of one if the drought occurred or zero otherwise.

Table 3: Summary of Variable Definitions and Measurement

Variables	Type	Definition	Measurement	Expected Signs
Treatment (PALVCI)	Dummy	Participation in aloe soap making	1 if yes, 0 otherwise	
Covariates				
AGEHH	Continuous	Age of head of household	In year	+
FSIZHH	Continuous	Number of household members	Number	+
SEXHH	Dummy	Sex of household head	1 if Male, 0 otherwise	+
EDUHH	Dummy	Education of household head	1 if literate, 0 illiterate	+
DMKT	Continuous	Distance to the nearest market	In Kilometers	-
CRDAC	Dummy	Credit accessibility to Household head	1 if access, 0 otherwise	+
ACEXT	Dummy	Access to extension services	1 if access, 0 otherwise	+
TLU	Continuous	Livestock holding size	Tropical Livestock unit	-
KAECU	Dummy	Knowledge about aloe plant economic uses	1 if yes, 0 otherwise	+
FMPASM	Dummy	Family members participating on aloe soap making		+
CMPASM	Dummy	Community income levels participating on aloe soap making		-
ASLDV	Dummy	Aloe soap supplementing livelihood diversification	1 if yes, 0 otherwise	+
ALMKTY	Dummy	Aloe soap marketability in the local market	1 if yes, 0 otherwise	+
ASCOMPT	Dummy	Aloe soap competency or preferable	1 if yes, 0 otherwise	-
PEASVCI	Dummy	Positive effects/rank of aloe soap value chain		+
RDGT	Dummy	Recurrent drought	1 if yes, 0 otherwise	-

Before proceeding to estimate the data using logit model, checking the existence of multicollinearity between explanatory variables tests were undertaken. The variance inflation factor (VIF) technique was employed to detect the problem of multicollinearity for the continuous variables VIF can be defined as;

$$VIF(X_i) = [1 - R_i^2]^{-1} \quad (13)$$

Where, R_i is the squared multiple correlation coefficient between and other explanatory X_i variables. The larger the value of VIF, the more troublesome it is. As a rule of thumb, if a VIF of a variable exceeds 10, the variable is said to be highly collinear.

Similarly, for dummy variables contingency coefficients (CC) test were employed using the following formula:

$$C = \sqrt{\frac{X^2}{n+X^2}} \quad (14)$$

Where C is contingency coefficient, X^2 is chi-square value and n = total sample size.

For dummy variables if the value of contingency coefficients is > 0.75 the variable is said to be collinear. Heteroscedasticity exists when the variances of all observations are not the same, leading to consistent but inefficient parameter estimates. More importantly, the biases in estimated standard error may lead to invalid inferences (White, 1980). Heteroscedasticity was detected by using Breusch - Pagen test (hettest) in STATA 12.

Finally, the Aloe soap value chain initiative effect on pastoral and agro-pastral households livelihood diversification strategy were estimated through STATA 12 software using psmatch2 developed by Leuven and Sianesi (2003). In addition SPSS version 16.0 software was deployed to analyze the descriptive statistics.

4. RESULTS AND DISCUSSION

In this chapter, the social, organizational and institutional effects of aloe based livelihood diversification; both descriptive and econometric results are presented and discussed. The descriptive analysis employs the tools such as minimum, maximum, mean, percentage, standard deviation and frequency distribution. In addition, t-test and chi-square (X^2) statistics were employed to compare participants and nonparticipants in to aloe soap value chain initiative technology with respect to some explanatory variables.

Econometric analysis was conducted in order to analyze if there are significant livelihood differences between participants and nonparticipants in to aloe soap value chain initiative and identify the socio-economic, demographic and institutional factors affecting participation. The study used PSM for identifying factors affecting participation in aloe soap value chain initiative and whether there are significant differences between participants and non-participants in terms of the income to enhance livelihood options.

4.1. Social, Organizational and Institutional Aspects of Aloe based Livelihoods

- **Social aspects of Aloe based Livelihood Diversification Strategies:** Based on the result obtained from FGD, the project interventions on the NRM and NR based income generation activities are economically affordable. Traditional pastoral adaptation strategies for coping with climatic effects and other shocks attempt to maintain their livelihoods through rational use of existing resources and affiliating with other neighboring communities to share scanty resources.
- The introduction of Aloe soap value chain initiative was not easily accepted by the community, because, the plant was not used to produce any economic benefits to the local community for longer period of time. It took time to convince the community to

use Aloe plant as source of livelihood and valuable to mitigate the risk of drought and other shocks (KII).

- The pastoral community were convinced that Aloe plant species are the most reliable and drought tolerant which grows throughout the year. Aloe plant species has now got recognition from the local government and community members as the potential income generating plant in supplementing the pastoral and agro-pastoral livelihood diversification strategies. Currently, this aloe soap value chain initiative was able to attract the attention of local government, donors, likeminded NGOs and observed being scaled up to adjacent districts and Guji Zone. During this survey period, there are about 12 aloe soap producing groups initiated and aloe plant domestication is being exercised (KII).

- **Organizational aspects of Aloe based Livelihood Diversification Strategies**: The pastoralists or agro-pastoralists groups were organized into cooperatives and union. That helped them share capital investments, gain bargaining power relative to middlemen, and enforce their contracts. In organizing themselves vertically, they benefited not only by collecting but also providing basic processing services in order to sell higher value aloe plant products on the market like soap for different purposes. At the same time, aloe soap production is restricted externally by the presence of input supply, fixed costs, lack of credit markets and the lack of infrastructures.

- **Institutional aspects of Aloe based Livelihood Diversification Strategies**: Under the umbrella and guidance of the customary institutions, pastoralists and agro-pastoralists of Borana have adapted in many ways to the uncertainty of their environment. As all respondents agreed, the pastoral livelihood assets such as natural, financial, human and social assets on which Borana community depend are significantly affected by recurrent drought, other human and climate related shocks. The pastoral and agro-pastoral communities have never tried to use aloe plant for supplementing their usual means of livelihood. They have been using aloe plant only for traditional medicines for both human and animals; and ritual purposes (FGD and KII).

4.1.1. Aspects of Institutional Networks on Aloe Soap Value Chain Initiatives

A successful marketing chain of actor and institutions are needed to bring an aloe soap product of satisfactory quality onto the market at a reasonable price. There were an endogenous lack of organizational structure, with lack of information, risk and vulnerability for the primary producers. This situation was improved by coordinating meetings among actors and setting up institutional relationships, such as a contractual arrangement between input suppliers and private traders at local and regional levels. This situation needed for horizontal and vertical integration to allow a more effective/equitable distribution of margins.

As IFPRI (2006) has stated, in certain countries, the expansion of cellular phone networks has greatly improved basic communications, making it possible for one actor to inquire about the spot price of a product before deciding to bring it to the market. It is also necessary to explore issues related to grants and credit guarantees for producers groups, in order to reduce the risk of production and facilitate market entry. More fundamental investment in infrastructures and transport always helps to increase efficiency within the market chain, lowering major sources of transaction costs.

In order to promote businesses based on Aloe plant species, product diversification into body lotions and shampoos is necessary to preserve minimum incomes for the aloe soap producers once market problems have been taken care of and products become profitable. Competitions occurred in the study area because of substitutions with other soap products introduced from cross border.

4.1.2. Aspects of CBOs on Aloe Soap Value Chain Initiatives

The FGD has revealed that the Borana pastoralists have been in a favorable position to develop an exceptionally efficient natural resource management. They were specialized on extensive cattle breeding in a semi-sedentary production system. The limited availability of permanent water at the traditional deep wells was the key variable that determined the rules for the utilization of pastures. Through flexible natural resource use strategies and stratified herd management they matched the livestock to the available grazing and water resources during times of abundance as well as in scarcity. Institutional arrangements and networking

within and between pastoral groups were elaborated to enforce decisions among multiple resource users by Community Based Organizations (CBOs) or local customary institutions.

In the target study area, livelihood revolves around livestock production, opportunistic farming and the exploitation of common property natural resources. Since the over-extraction of natural resources poses a threat to biodiversity, reconciliation between income generation and conservation will be a realistic step to underpinning the goals of sustainable resource management and at the same time improving livelihood diversification strategy through well informed CBOs.

To make the social, organizational and institutional aspect of aloe soap value chain initiative more productive to the target community; a market oriented production system must entail several key characteristics. These are standardized and environmentally friendly production procedures and a standard *marketing mix* by the producers and traders of aloe plant-based herbal products are vital. Therefore, investigating appropriate devices is a major challenge in managing aloe plants resources, regardless of whether marketing (utilization) and conservation co-exist through a livelihood enabled production system.

Aloe soap production from aloe plant species has become socially acceptable employment avenues for women (personal observation). These typically include soap product from aloe plant raw materials that are collected, processed and sold. Aloe plants product is now becoming family - based health (sanitation and hygiene) and livelihood oriented enterprises in the pastoral and agro-pastoral areas of the targets under study. Traditional healers have been running aloe plant based health care systems to earn their livelihoods. This aloe soap is preferred by most of the community members or the consumers by its medicinal value of ecto-parasites (like fungus and bacteria) and its skin moisturizing effect in addition to its detergent effect.

Finally, the KIIs from government, SOS project staffs and community have clearly described that CBOs have a greater role in promoting aloe plant production and productivity subsector. In turn, this needs a new push and direction by defining a set of parameters to design and develop a people centered, livelihood focused, and market oriented production systems vis-a-vis conservation system. This needs to recognize both the opportunities and the challenges faced by the aloe plants product development sub-sector and to plan a holistic program.

Meanwhile, biodiversity enhancement and livelihoods improvement goals need to be treated as an integral part of the operation. Moreover, ecological and environmental factors, regulatory mechanisms, technology choice and costs, market information, and the availability of professional extension and support services are the key points that need to be considered in the aloe based livelihood diversification strategy.

4.2. Description of Sample Households' Characteristics

A combination of different descriptive statistics was performed on the sample households' data to inform the subsequent empirical data analysis. To describe the sample households included in this study both continuous and discrete variables were used. The descriptive statistical analysis was run to observe the distribution of the independent variables.

The socio-economic and institutional characteristics of the sampled households such as age, sex, family size, market distance, extension visit, accesses to credit, livestock holding, were identified to affect participation in the program. Of the total 120 sample respondents interviewed 60 were participants and the rest were non-participants of aloe soap making technologies (Table 4).

Table 4: Summary Statistics of Variables

Variable	Mean	Std. Dev	Min	Max
FSIZHH	6.64	2.99	2	16
PALVCI	0.5	0.5	0	1
SEXHH	0.43	0.5	0	1
AGEHH	38.24	13.73	18	87
EDUHH	1.46	0.94	1	4
PASP	1.13	0.42	1	3
KAECU	0.58	0.5	0	1
FMPASM	5.13	15.67	1	
CMPASM	2.4	1.19	1	4
ASLDV	0.93	0.25	0	1
ALMKTY	0.43	0.5	0	1
ASCOMPT	0.77	0.42	0	1
MCOOP	0.5	0.5	0	1
CRDAC	0.7	0.46	0	1
DMKT	12.09	3.29	5	15
ACEXT	0.7	0.46	0	1
RFINSC	205.11	435.79	1	
RDGT	0.83	0.37	0	1
PEASVCI	2.6	0.76	1	4
TLU	9.43	11.72	0	75

4.2.1 Respondents Total Income (TOINC) Estimate per Month

Under favorable conditions, that is, if the ingredients such as caustic soda, vegetable oil, water and aloe sap, are available and other things remain constant, those household members who participate in aloe soap making business have more income than those who are not. Participant households undertake the aloe soap making business parallel to their usual livelihood activities and able to fetch their additional income. Note that the participants' income is not only from aloe soap sales, but also from livestock and livestock products sales

and other incomes they are opt to get under normal circumstances. It shows that the participant's income is better than those non-participant households (Table5).

Table 5: Respondents Total Income per Month (TOTINC) in Birr

PALVCI	mean	Std. Dev.	min	max
Non-participant	1647.00	846.11	540.00	3510.00
Participant	4731.31	1019.63	2801.54	6866.16

As the result in Table 5 shows, the mean monthly income of non-participants' is Birr1647.00 whereas that of participants' monthly mean income is Birr4731.31. The participants' monthly mean income is higher due to the income they additionally obtain from aloe soap processing business.

4.2.2 Respondents Rank and Perception of the Aloe Soap Making Business

From all the respondents, there was no any negative effect reflected directly or indirectly. The survey question was forwarded to check whether there exists any cultural or traditional situation which hinders the community from using aloe plant for generating income. As shown in Table 6, about 7% of the total women respondent and none of men have said that aloe soap business has poor or no significant effect on their livelihood diversification strategy. The majority of the respondents lay between good and very good way of positive attitude if than aloe soap marketing value chain initiative is promoted. Similarly, 12% of total women respondent and 14% of men respondents have said that aloe soap business has an excellent positive contribution in supplementing their livelihood.

Table 6: Rank of Positive Effects of Aloe Soap Making Business

Sex	Poor		Good		Very good		Excellent		Total	
	N	%	N	%	N	%	N	%	N	%
Female	5	7	29	42	27	39	8	12	69	57.5
Male	0	0	24	47	20	39	7	14	51	42.5
Total	5	4	53	44	47	39	15	13	120	100

The respondents were requested to express their perception based on sex category and ranked their perception as in Table 7. The 93% of from the total respondent women and 88% of men expressed their perception as they favor the aloe soap making business

Table 7: Respondents' Perception of Aloe Soap Making Business

Sex	Favor/good		Moderate/neutral		Disfavor/not good		Total	
	N	%	N	%	N	%	N	%
Female	64	93	3	4	2	3	69	57.5
Male	45	88	4	8	2	4	51	42.5

4.3. Prospects & Determinant Factors of Aloe based Livelihood Diversification

Pastoralists have developed elaborate and complex mechanisms and institutions that enable flexibility and opportunity mainly herd mobility and diversification. These institutions govern mobility, resource use and redistribution, and have enabled pastoral societies to withstand extreme pressures of both their environment and their competitors. The study has revealed that wild aloe vegetation was thought to be abundant but has negligible economic contribution to the livelihoods of the sample pastoral community. It was confirmed through KIIs that Aloe soap value chain initiative was introduced to Borana by SOS Sahel before seven years during 2008/2009 on a trial basis through community participation. Before this initiative, aloe plant was considered as invading plant covering their grazing areas. Hence, the community has applied to the zonal government offices to clear-out the aloe plant species (FGD and KII).

To ensure institutional sustainability, different capacity building activities at community and government level were provided and attempt to link the aloe based cooperatives/groups to the respective government institutions through legal registration and forums. Due to the intervention of aloe soap value chain initiatives in the study area, there are magnificent changes observed regarding the economic use of aloe plant. Prior to the intervention, the aloe plant species were considered as invading bush encroachment except its traditional medicinal and ritual services. After the intervention, the aloe soap product was promoted at all events both at local and national level. There were many networks created from the local traders in the region to central city Addis Ababa. This innovative approach of making soap from underutilized aloe plant species has alerted all the local community members, customary

institution, government and NGOs to promote as one of the livelihood diversification options in the Borana rangelands.

Hence, FGD, KII and personal observation reveals that the aloe soap value chain initiatives has got a wider acceptance from all corners that the households were initiated and organized into cooperative forms, the government has given them a legal certification or work permit in aloe soap production and even encouraged them to be organized in to 'Aloe Soap Producers and Forest Resources Products Marketing Cooperatives Union' at Zonal level. The Borana Zone Administration has given a place/land to construct bio-enterprise center where all the range land products like aloe soap, gum and incense, honey and scent wood can be sold. Some NGOs operating in Borana are now encouraging those interested pastoral and agro-pastoral communities to domesticate aloe plants and fetch their income in a more advanced way than before.

The aloe soap value chain system includes the individual households, customary institutions, CBOs, input suppliers, the government line departments like cooperative Offices, Children and Women Affaires, primary cooperatives, the cooperatives union, financial institutions like Banks, NGOs, private traders, wholesalers, retailers and consumers. However, there is no as such matured Aloe soap value chain systems developed in the area except input supply, product development, promotion and marketing. Hence, the prospects of aloe soap value chain initiative is promising to be more productive and relatively best option in supplementing the livelihoods of the respective rural poor and gradually support the local economic transaction which may lead to advanced and diversified products of aloe plant species found in the country.

4.4. Econometric Results of Propensity Score Matching

As shown below, this section discusses the results of Propensity Score Matching in detail. To measure the average treatment effect on the treated (ATT) for outcome variables, a logit model was estimated in order to get the propensity scores. The odds ratio and marginal effect is run to identify the variable on the level of household participation. Next a matching estimator that best fit to the data was selected. Then based on those scores estimated and matching estimator selected, matching between participants and non-participants was done to

find out the impact of the project on the mean values of the outcome variables. Therefore, this section illustrates all the required algorithms to calculate the average treatment effect on the treated, which helps us to identify the impact of the project.

4.4.1 Odds Ratio and Households Participation in Aloe Soap Processing

The odds ratio depicted in the Table 8 below shows that the coefficients of variables which are influencing the probability of households to participate or not in the aloes soap making business. Interpretation of coefficients will be easier if the logistic model can be written in terms of the odds and log of odds (Gujarati, 2004). The odds ratio implies the ratio of the probability that an individual will be a participant (P_i) to the probability that he/she will not be a participant ($1 - P_i$). The odds ratio is one of a range of statistics used to assess the risk of a particular outcome (or disease) if a certain factor (or exposure) is present. The odds ratio is a relative measure of risk, telling us how much more likely it is that someone who is exposed to the factor under study will develop the outcome as compared to someone who is not exposed. Odds are a way of presenting probabilities, but unless you know much about betting you will probably need an explanation of how odds are calculated. The odds of an event happening is the probability that the event will happen divided by the probability that the event will not happen.

Westergren et al., (2001) has stated that if the odds ratios are greater than one, then the event (in our case, 'participation into aloe soap value chain initiative') is more likely to happen than not. If the odds ratio are less than one, then the event is less likely to happen than not.

Hence, as seen in the Table 8 below, age, second cycle of education (i.e., grade 5-8), Knowledge about Aloe economic use (KAEU), Family members participating on aloe soap making process (FMPASM), aloe soap supporting livelihood diversification (ASLDV), Aloe soap marketability (ALMKT), Aloe soap competency in the market (ASCOMPT), distance from the market (DMKT), access to extension services (ACEXT) and livestock holding (TLU) has more likely to participate and contributes to the households' income through aloe business.

Table 8: Logistic Regression of Odds Ratio of Participants

Variable	Odds Ratio	Standard Errors	Z-Value
FSIZHH	1.086*	0.109	0.82
SEXHH	0.381	0.204	-1.80
AGEHH	1.001	0.022	0.70
EDUHH			
2	0.482	0.403	-0.87
3	0.573	0.708	-0.45
4	0.422	0.624	-0.58
KAECU	3.540*	2.658	1.68
FMPASM	1.028	0.012	2.42
CMPASM	0.796	0.206	-0.88
ASLDV	12.996*	15.046	2.22
ALMKTY	3.964*	2.214	2.47
ASCOMPT	8.358*	7.542	2.35
CRDAC	1.025	0.629	0.04
DMKT	1.104*	0.101	1.07
ACEXT	0.863	0.456	-0.28
RDGT	0.615	0.545	-0.55
PEASVCI	0.574	0.215	-1.48
TLU	1.065*	0.028	2.41
_cons	0.007	0.018	-1.96

* Shows the variables that have a higher contribution to participate in aloe soap making business

NB: In EDUHH (Education of the HH)1 represents the illiterate sample (EDUHH) and serve as the reference point; 2 represents samples with grade 1-4; 3 represents grade 5-8; and 4 represents grades 9-12.

4.4.2. Propensity Scores

Prior to running the logistic regression model to estimate propensity scores, the explanatory variables were checked for existence of sever multicollinearity problem. A technique of Variance inflation factor (VIF) was calculated to detect the problem of multicollinearity

among continuous explanatory variables. Accordingly, the VIF (X) result shows that the data had no serious problem of multicollinearity (Appendix2). This is because, for all continuous explanatory variables, the values of VIF were by far less than 10. Therefore, all the explanatory variables were included in the model (Appendix 3).

Moreover, heteroskedasticity test was done using Breusch-Pagan/Cook-Weisberg test for heteroskedasticity and the P-value was 0.2954 which is insignificant implying the absence of the problem of heteroskedasticity (Appendix 4).

A logistic regression model was used to estimate the propensity scores of respondents which helps to put in to practice the matching algorithm between the treated and control groups. The matching process attempts to make use of the variables that capture the situation before the start of the intervention. The logit result revealed a fairly low pseudo R^2 of 0.4057 (Table … (below). The pseudo-R^2 indicates how well the regressors *X* explain the participation probability (Caliendo and Kopeinig, 2005). A low R value means participant households do not have much distinct characteristics overall and as such finding a good match between participant and non-participant households becomes easier (Yibeltal, 2008).

The maximum likelihood estimate of the logistic regression model result shows that participation was influenced by 5 variables (Table 9). These are family size, education level, distance from nearest market, access to extension service and recurrent drought affect the chance of participation. In addition, households having higher number of livestock are more likely to be a participant in the market development interventions of the aloe soap value chain initiatives project and this is on the contrary to the finding of Zikhali (2008) in Zimbabuwe.

Table 9: Logit Results Household Program Participation

Variable	Coefficient	Standard Errors	Z-Value
FSIZHH	0.083*	0.105	0.79
SEXHH	-0.965***	0.541	-1.78
AGEHH	0.001**	0.023	0.06
EDUHH			
2	-0.730***	0.894	-0.82
3	-0.556***	1.235	-0.45
4	-0.863***	1.082	-0.80
KAECU	1.264**	0.646	1.96
FMPASM	0.027**	0.022	1.26
CMPASM	-0.228***	0.226	-0.89
ASLDV	2.565**	1.286	1.99
ALMKTY	1.377	0.553	2.49
ASCOMPT	2.123	0.746	2.84
CRDAC	0.024*	0.580	0.04
DMKT	0.099*	0.089	1.11
ACEXT	-0.148***	0.561	-0.26
RDGT	-0.486***	0.790	-0.61
PEASVCI	-0.555***	0.366	-1.52
TLU	0.063**	0.027	2.30
_cons	-4.921	2.781	-1.77
Number of Obs	120		
Wald chi2(18)	60.090		
Prob > chi2	0.000		
Log pseudo likelihood	-53.132		
Pseudo R2	0.361		

***, ** and * means significant at the 1%, 5% and 10% probability levels, respectively.

NB: In EDUHH (Education of the HH) 1 represents the illiterate sample and serve as the reference point; 2 represents samples with grade 1-4; 3 represents grade 5-8; and 4 represents grades 9-12.

4.4.3. Matching Participant and Comparison Households

As already noted, choice of matching estimator is decided based on the balancing qualities of the estimators. According to Dehejia and Wahba (2002), the final choice of a matching estimator was guided by different criteria such as equal means test referred to as the balancing test, pseudo-R^2 and matched sample size. Balancing test is a test conducted to know whether there is statistically significant difference in mean value of per-treatment characteristics of the two groups of the respondents and preferred when there is no significant difference. Accordingly, matching estimators were evaluated via matching the participant and non-participant households in common support region.

The estimated model appears to execute well for the intended matching exercise. The pseudo-R^2 value is 0.35 (Table 10). The pseudo- R^2 indicates how well the covariates explain the participation probability. Therefore, a matching estimator having balanced (insignificant mean differences in all explanatory variables) mean, bears a low pseudo R^2 value and also the one that results in large matched sample size is preferred. In line with the above indicators of matching quality, kernel of Epanechnikov type (default to kernel matching) with no band width is resulted in relatively low pseudo R^2 with best balancing test (all explanatory variables insignificant) and large matched sample size as compared to other alternative matching estimators indicated in Table 10. Then it was selected as a best fit matching estimator for dataset.

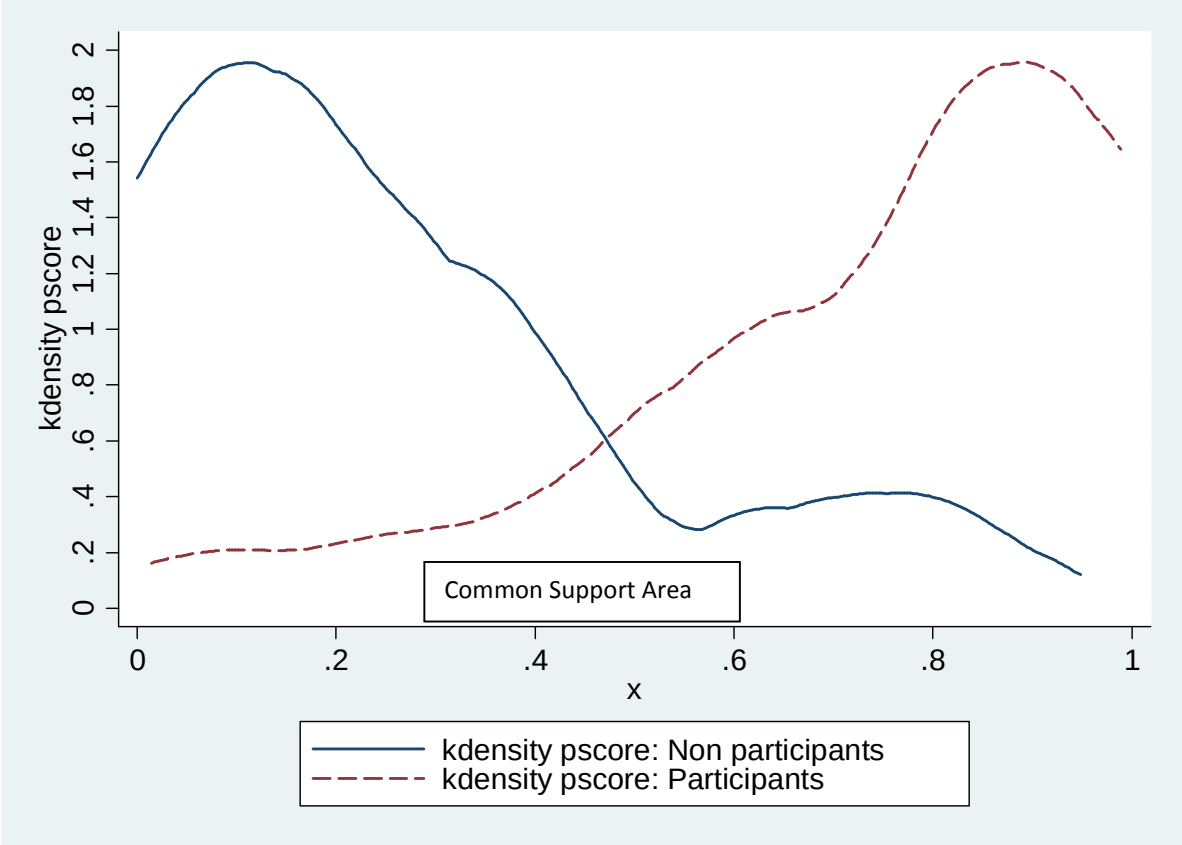
Table 10 : Logistic Regression for Choices of Matching Algorithm

Variable	Coefficient	Standard Errors	Z-Value
FSIZHH	0.083*	0.105	0.79
SEXHH	-0.965***	0.541	-1.78
AGEHH	0.001**	0.023	0.06
EDUHH			
2	-0.730***	0.894	-0.82
3	-0.556***	1.235	-0.45
4	-0.863***	1.082	-0.80
KAECU	1.264*	0.646	1.96
FMPASM	0.027**	0.022	1.96
CMPASM	-0.228***	0.256	-0.89
ASLDV	2.565	1.286	1.99
ALMKTY	1.377*	0.553	2.49
ASCOMPT	2.123	0.746	2.84
CRDAC	0.024**	0.580	0.04
DMKT	0.099**	0.089	1.11
ACEXT	-0.148***	0.561	-0.26
RDGT	-0.486***	0.790	-0.61
PEASVCI	-0.555***	0.366	-1.52
TLU	0.063**	0.027	2.30
_cons	-4.921	2.781	-1.77
Number of Obs	120		
Wald chi2(18)	34.65		
Prob > chi2	0.011		
Log pseudo likelihood	-53.132		
Pseudo R2	0.361		

***, ** and * means significant at the 1%, 5% and 10% probability levels, respectively.

NB: In EDUHH (Education of the HH) 1 represents the illiterate sample and serve as the reference point; 2 represents samples with grade 1-4; 3 represents grade 5-8; and 4 represents grades 9-12.

Figure 4: Graph of Kernel density of propensity score distribution



Source: Field Survey 2014

On the basis of this participation model, we then computed the distribution of the propensity score for each household included in the treated and control groups to identify the existence of a common support. Figure 7 portrays the distribution of the household with respect to the estimated propensity scores. Most of the treatment households are found in the right side and partly in the middle. On the other hand, most of control households are found in the left side of the distribution. In general, the graph shows that there is wide area in which the propensity score of participants is similar to those of nonparticipants.

4.4.4. Estimates of Average Treatment Effect on the Treated (ATT) Income

Given that those who follow through in participating may very well be systematically different from those who are assigned to treatment but do not participate, it may not be appropriate to simply compare those randomized to treatment with those in the randomized-out control group. The voluntary nature of participation in many interventions introduces the potential for **selection bias**, where we only observe outcomes for a nonrandom subsample of all units assigned to treatment. This is an example where propensity-score matching (PSM) could be used to match participants with members of the control group who are similar in the same selective ways as those who receive services.

As shown in Table 12, the ATT reveals that participants would have lost a physical amount of birr near to 2688.70 if they didn't participate in aloe soap making business. The difference that the participants can make in fetching their additional income is that totals to about Birr2688.70 per month.

Table 11: Estimate of ATT of income per month

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
TOTINC	Unmatched	4731.31	1647.00	3084.31	171.05	18.03
	ATT	4683.21	1994.51	2688.70	343.72	7.82
Note: S.E. does not take into account that the propensity score is estimated						

5. CONCLUSONS AND RECOMMENDATIONS

5.1 Conclusions

This study found out that in addition to the traditional pastoral livelihood diversification strategies which is based on livestock and livestock products, the sample households were hunting alternative livelihood strategies including aloe soap making. Furthermore, the study concludes that households differed on the actual livelihood strategies adopted depending on the sex, age and family member participating in the aloe soap making business. The sample households faced challenges due to recurrent drought, unusual settlements, expansion of farm lands, clan conflict, human capital (illiteracy & lack of appropriate skills). At the same time, aloe soap production is restricted externally by the presence of input supply, fixed costs, lack of credit markets and the lack of infrastructures.

As shown in the result, there was cross-sectional data (2012-2013) collected from both participant and non-participant sample households and analyzed using propensity score matching method. Accordingly, the average treatment effect on the treated (ATT), that is, the difference between the mean values of the outcome variable of treated and control of the intervention has shown the total income earned per month. The participants have received a total income of about Birr 2688.70 (Two Thousand Eight Hundred Eleven Birr and 88 cents) per month (Table 11) from the aloe soap production over the counter parts. This difference was found to be significant at 5% level.

The aloe soap value chain initiative was implemented to supplement the pastoral and agro-pastoral livelihood diversification strategies. Thus, the sample households had diversified their livelihood strategies to ensure survival and meet desired livelihood outcomes. The pursuit of aloe based alternative livelihood strategies was a struggle against challenges, which needed collective solutions from community, elders, customary institutions, the government, research centers and NGOs to guarantee success.

There was a significant association observed between increased vulnerability of a livestock-only livelihood strategy and adoption of alternative livelihood diversification strategies. Similarly, there was a significant association between household characteristics and pursuit of alternative livelihood strategies.

The finding of this study applies to these particular sample households who have access to aloe based livelihoods. They cannot be regarded as representative for all pastoralists and agro-pastoralists in Borana. However, these insights provide an impression of how the livelihoods diversification strategies can be supplemented by aloe based products in Borana and similar agro-ecologies and vegetation covers in the country. The constraints are likely to exist elsewhere and set the frame of aloe based production potential as well as engagement in additional activities, perhaps even within most rural, small-scale pastoral and agro-pastoral households in Borana.

The fact that different livelihood strategies were identified indicates a tendency that calls for different targeted interventions. The aloe soap processing activities are, however, currently not equally accessible to all households. As the non-livestock activities are to be conducted as either additional activities or alternative activities, it is possible that even the poorest household can benefit. Therefore, prioritizing a focus on aloe based alternative livelihood diversification activities hence appears to be the most reasonable strategy, as the strategy is to address the destitute households as well.

5.2 Recommendations/Suggestions

The finding of this study reveals a positive and statistically significant effect of the project on participants, an effort of such kind plays a vital role in making pastoralists and agro-pastoralists market oriented and makes them better off by making their aloe soap making a business enterprise. The increased level of input use (ingredients, machineries/equipment, and market information and access) by the side of participants made them beneficiaries of the increased productivity and earners of higher net income and profits. The development of input market of such kind which is participatory - supplied by the private sector, integrated (multifaceted), and sustainable with the provision of market information and new ways of doing can increase the welfare of the communities in the long run and income in the short run.

In addition, it was observed that the interventions that were delivered by the project were not the kind that develop dependency syndrome among the beneficiaries. It was a kind of making beneficiaries self-reliant and resilient as to from where aloe plant is found, as to how to plan domestication and conservation of the wild aloe plant, to whom to sell and more interestingly as to how to make informed decision regarding aloe soap producing and marketing. Therefore, there has to be such an institution which serve as a bridge among the stakeholders, stimulate the use of NTFPs like the abundant and underutilized aloe plants in the region informing the pastoral development offices and the CBOs (co-operatives) and 'innovative knowledge adviser' in the nation at large.

Moreover, scaling up of the aloe soap value chain initiative practice of the project to other places has paramount importance for the development endeavor of the country in line with enhancing food security of the rural poor and mitigation of the rigorous climate change affecting the world. Based on the above results, the following are some of the recommendations that need to get due attention by all stake holders working with pastoralists, agro-pastoralist and other areas with similar available plant vegetation:

- ✓ The research centers and government line departments, and customary institutions need to value the existing natural resources through value addition and innovative interventions than focusing on handouts that promotes dependency syndrome.

- ✓ Promote Aloe soap value chain initiative to support the indigenous adaptation mechanisms which are environmentally sound and effective. Aloe plant based intervention has multiple advantages as it is drought tolerant, good in soil and water conservation and medicinal value to both human and animals.

- ✓ Introduce the alternative livelihoods diversification strategies like aloe soap production activity that may reduce the consequences of depending on livestock only, which directly depend on natural resources and highly sensitive to human and natural triggered shocks.

- ✓ Incorporate aloe plant production and conservation issues in to the local government development programs and extension services to improve the resilient (resistance to hazards) capacity of pastoralists and means of minimizing its impact to recurrent shocks. As aloe plant resource is highly exposed to overexploitation under current circumstance, attention should be given for the conservation and protection of these aloe plant species.

- ✓ Undertake further research on how to invigorate aloe plant cultivation, propagation and product diversification.

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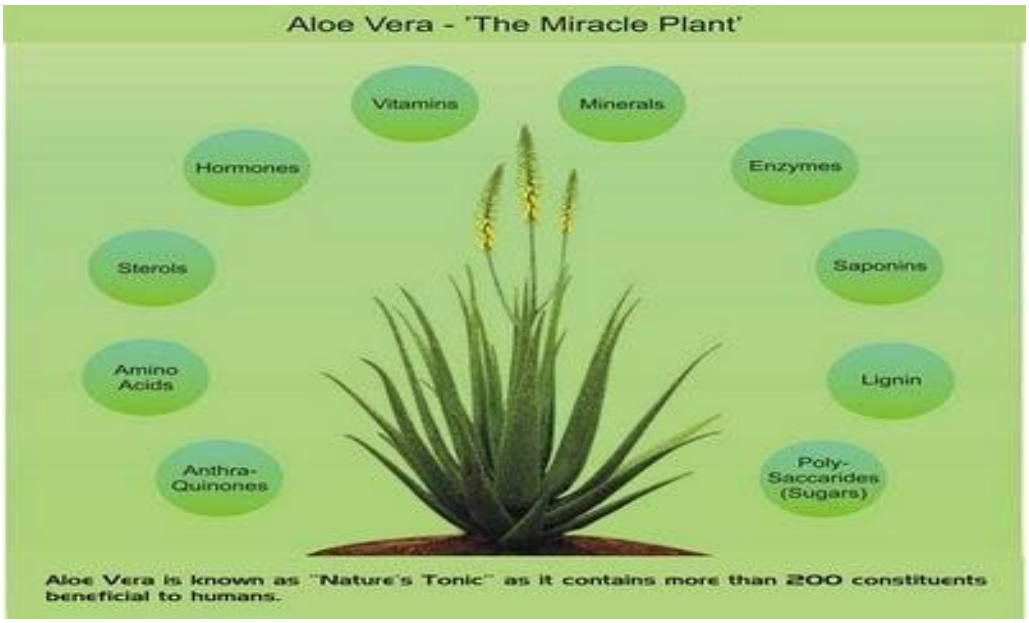
APPENDICES

Appendix 1 Conversion Factors Used to Estimate TLU

Types of animals	TLU
Cow	1
Ox	1
Bull	1
Heifers	0.75
Cafe	0.40
Sheep/ Goat	0.10
Donkey	0.50
Horse/ mule	0.80
Camel	1

Source: Freeman *et al.,* (1996)

Appendix 2: Aloe Vera Plant and the Bioactive Chemical Constituent



Source: Adapted from (http://mumbai.olx.in/*Aloe-vera*-products-id-4852352)

Appendix 3: Multicollinearity Test for Continuous Explanatory Variables

Variable	VIF	1/VIF
FSIZHH	1.50	0.668
SEXHH	1.33	0.750
AGEHH	1.66	0.601
EDUHH		
2	1.37	0.732
3	1.18	0.846
4	1.51	0.663
KAECU	1.53	0.652
FMPASM	1.23	0.810
CMPASM	1.51	0.664
ASLDV	1.11	0.898
ALMKTY	1.24	0.809
ASCOMPT	1.21	0.827
CRDAC	1.18	0.844
DMKT	1.31	0.765
ACEXT	1.23	0.814
RDGT	1.28	0.783
PEASVCI	1.30	0.772
TLU	1.27	0.789
Mean VIF	1.33	